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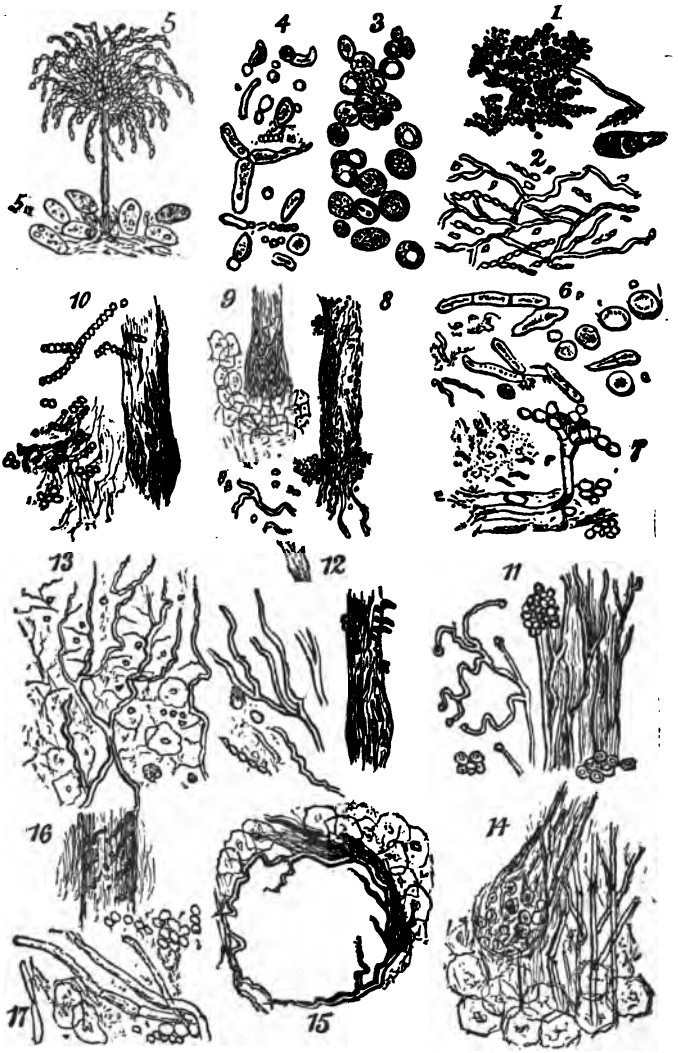
PARASITIC DISEASES

HOGG









Graphotype.

PARASITIC FUNGI.

A

PARASITIC OR GERM THEORY

OF DISEASE:

THE SKIN, THE EYE, AND OTHER AFFECTIONS;

BY

JABEZ HOGG,

Surgeon to the Royal Westminster Ophthalmic Hospital; Ophthalmic Surgeon to the Royal Masonic Institution; Consulting Ophthalmic Surgeon to the Hospital for Diseases of Women and Children, Vincent Square; late President of the Medical Microscopical Society, and Vice-President of the Medical Society, London; Hon. Fellow of the Academy of Sciences, Philadelphia, and of the Belgian Microscopical Society; F.R.M.S., &c. &c.

SECOND EDITION.



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A TREATISE ON THE USE OF THE OPHTHALMOSCOPE IN DISEASES OF THE EYE.

THE MICROSCOPE, ITS HISTORY, CONSTRUCTION, AND APPLICATIONS.

ELEMENTS OF EXPERIMENTAL AND NATURAL PHILOSOPHY, ETC.

PREFACE TO FIRST EDITION.

It has frequently been suggested to me that my papers "On the Vegetable Parasites infesting the Human Skin," together with some others on "The Fungoid or Germ Theory of Disease," which lie scattered through the serial publications of 1859 to 1872, possess sufficient interest to warrant a re-publication in a collected form. Investigations made in connection with the question of a fungoid theory of disease having occupied much of my time and attention, it will be seen that in this collection of papers I have endeavoured to bring together matters of interest bearing upon the infective nature and character of certain diseases in relation to the public health.

1, Bedford Square,

August 1st, 1873.

DESCRIPTION OF PLATE.

FIG.

1. Fungi, taken on a glass slide exposed to a current of air.
2. Algoid filaments growing in distilled water.
3. Healthy yeast-cells from sweet-wort, a little too dark in colour, and too full of granular matter.
4. Exhausted yeast, from the bottom of a porter vat.
5. A tuft of penicillium glaucum. *5a*. Spores more highly magnified.
6. Achorion Schönleinii, from a favus crust ferment in sweet-wort.
7. Achorion Schönleinii, from sweet-wort freely exposed to light; penicillium mycelia, spores, and bacterium-like bodies growing in the same.
8. Microsporon Audouini, from a case of alopecia.
9. Fungoid spores and epithelium cells surrounding a hair, from a case of alopecia.
10. Tricophyton tonsurans, from a ringworm crust.
11. Microsporon furfur, from a case of pityriasis versicolor.
12. Microsporon mentagrophytes, from the beard of a patient suffering from sycosis.
13. Fungus spores and mycelium, from a case of psoriasis.
14. Fungus mycelium and epithelium scales, from a case of lepra.
15. Fungus mycelium and epithelium scales surrounding a hair, from a case of eczema.
16. Fungus spores, from a case of lichen.
17. Fungus spores and mycelium, from a case of tinea tarsi.

INTRODUCTION.

SINCE the publication, in a collected form, of my papers on "The Fungoid or Germ Theory of Disease," a somewhat remarkable discussion has taken place on the subject in the Pathological Society of London, and which on the whole appears so very confirmatory of the views I promulgated in 1859, and subsequently, that I am tempted to give a brief resumé of the question as it now stands.

I may state that soon after the publication of Professor Tyndall's letters in the *Times*, on the "Germ Theory of Disease," in April, 1870, Dr. Angus Smith, who had long held somewhat similar views on the question, stated at a meeting of officers of health, that he was no longer able to believe in the germ theory. Considering that Dr. Smith had long held certain views on disinfection, and which were so intimately associated with "organic germs," I conclude that he must have had very good grounds for this public recantation. Since that period the eminent physicist before alluded to has remained silent; his reasoning, however, on the question at issue—namely, that in the main "the germ theory is the right and true theory of infectious and contagious diseases"—he attempts to establish by the following argument, which may be put syllogistically:—Putrefaction of blood, or pus, is disease; the cause of putrefaction is animalcules or their germs; therefore, animalcules, or their germs, are

the cause of disease, and the germ theory of disease is the true one. It will not be denied that Professor Tyndall's experiments on dust have no bearing on any of the members of the above syllogism, except the second or minor premise, namely, the cause of putrefaction is animalcules or their germs. But, whatever may be their importance in that connection, it is evident that unless the major premise be sound, all the rest is a baseless fabric. Now, in my humble opinion, the latter is utterly unsound. The steps by means of which pus and blood putrefy—whether initiated by, and exclusively due to, the presence of animalcules derived from without, according to the Panspermists; or, on the other hand, according to the Heterogenists, only accelerated by infusorial organisms, which are themselves derived from the elements of putrescent matter—is not a morbid process, nor even one proper to living bodies, but a normal result of the operation of the laws which regulate the breaking up of organised matter. Some of the products of this process, under certain circumstances, are, undoubtedly, capable of inducing morbid action, but the process itself is not disease. Grant putrefaction to be satisfactorily explained by the invasion of animalcules, or their germs, and little or no light would thereby be thrown on the intimate nature of disease; for although certain morbid processes have, with reason, been compared to putrefactive fermentation, they cannot be admitted to be identical therewith.

Professor Tyndall's argument, also, in favour of the cause of putrefaction being animalcules, or their germs, is equally fallacious. It runs thus:—Whereas the outer air (supposed to be always charged with germs capable of inducing putrefaction), entering the pleural cavity by an external wound and there commingling with blood, is liable to cause putrefaction; air from the lungs, when it meets inside the pleura, with blood coming from an

internal wound, caused say by the spike of a broken rib, does not give rise to putrefaction; but the air, which passes through the lungs in respiration, is known to be deprived, by a kind of filtration, of the particles of solid matter suspended in it; therefore the difference of the results in these two cases must be due to the filtering out by the lungs of the supposed germs from the air in the latter. If all the other conditions, under which exist these two airs, were the same, it would, no doubt, be logical to argue that the absence, or presence, in them of solid particles of some sort (not necessarily living germs, however) was the cause of the difference in question. But so far from this being the case, both air and blood, as they exist in the minute pulmonary air vesicles and blood vessels, are under conditions totally distinct from those that would affect the air and blood which might meet in the pleural cavity from an external wound. In the matters of temperature, pressure, and perhaps electricity, the conditions are entirely dissimilar. The lungs, moreover, cannot be constantly filtering out from the inspired air, and retaining "germs," without becoming largely charged with these bodies. This being so, the blood which is sometimes exuded into the air passages in lung disease, or at other times is discharged therein from a ruptured vessel, coming in contact with so great an accumulation of septic germs, ought to be particularly liable to putrefaction. But this is not the case; nothing the least like it has ever been observed.

Dr. Bastian, after due consideration, is clearly of opinion that the "physico-chemical theory" explains both fermentative and zymotic processes, and necessarily putrefactive changes. His words are: "I would maintain that facts already known abundantly suffice to displace the narrow and exclusively vital (germ) theory, and to re-establish a broader physico-chemical theory of fermentation. Whether the ferment in any given case be

an independent living organism ("organic germ"), a fragment of non-living organic matter, or some mere physico-chemical influence, as in the case of the action of finely divided platinum, the indicative change is in each case a result of chemical action. And similarly with regard to "contagium," whether it be an independent living organism, an altered though living tissue element, a fragment of dead organic matter, a chemical compound, or even the more vague influence of a "set of conditions" which suffices to generate contagium *de novo*, we have in each case to do with gradually initiated chemical changes, destructive in kind and gradually terminating in one or other of the recognised varieties of zymotic affections. The changes in each case, even when we have to do with living ferments or living contagia (bacteria or fungi), would be due only to an infinitesimal extent to the organic multiplication of such units, though the decompositions and chemical changes set up by them in their respective fluids may be such as to lead to the formation of a continuous set of independent organisms."

The relationship existing between zymosis and the modified processes of fermentation taking place in fruits and tubers seems, indeed, far more close than that between the zymotic processes in animals and the ordinary kinds of fermentation or putrefaction occurring in organic fluids. In processes occurring in vegetable tissues, as well as in those morbid phenomena met with in animals, the presence of rapidly multiplying independent organisms is an occasional rather than a necessary feature. Though usually absent in other allied processes, organisms invariably manifest themselves throughout the tissues of the beetroot and of the potato, when these are placed under certain abnormal (unhygienic) conditions. Very many illustrations can be adduced which favour these views. "It is a well-established fact that one of the most fatal diseases known to occur

in silkworms (muscardine) can be generated *de novo*. This fatal disease—a disease in which fungoid elements are found in the blood and growing through the various tissues of the body—elements, too, not at all dissimilar to some of the elements met with in ovine smallpox—may be produced quite easily by shutting the silkworms up in a glass-bottle or box, and by overfeeding them for a time. Under these conditions their blood soon swarms with characteristic organisms, and the fungus grows through all the tissues of the body. When thus affected, the animal is capable of spreading the disease to other silkworms with which it may be brought into contact; for it is an eminently contagious disease, and if we look at sheep-pox itself, the facts at present known are surely irreconcilable with the notion that the organisms formed in the diseased tissues are themselves the cause of the disease. After the first local contact of the contagium with some surface, it is subsequently supposed to multiply and be disseminated through the body by means of the blood. But, on the other hand, it is a well-attested fact that inoculation with the blood of an animal suffering from ovine small-pox does not produce the disease in another animal. How can those who believe in the germ theory for ovine small-pox account for this absence of germs from the blood?"

With regard to cholera, Dr. Lewis and Dr. Cunningham, who have been engaged in a special inquiry into the nature and causes of this disease, are of opinion that it is not contagious; that it is infectious seems also doubtful; and the results at which they have arrived is apparently that the prevalence of the disease is intimately connected with meteorological phenomena (chemico-physical), though of the nature of the connexion nothing at present is known. Dr. Cunningham, moreover, is convinced that cholera is due to certain conditions of air and soil which are as yet but little understood.

"With these facts before us," observes Dr. Bastian, "we are asked to believe in a germ theory of disease, because the phenomena of specific fevers are supposed to be alone capable of explanation by reference to the multiplication of hypothetical organisms within the body. But, as Dr. Murchison has said, 'it seems that the facts in question are equally capable of being explained in other ways.' The same may be said of so-called parasitic diseases of the skin, and the practical outcome of the recent discussion is that, tying ourselves down to no exclusive theories, we are taught, whilst excepting the facts of contagion, not to be pure contagionists, but rather to look abroad and around us, and seek for the conditions of origin of contagious diseases. The ravages of typhus in our crowded cities and in our gaols have been enormously curtailed, not so much because of its diminished spread by contagion, but rather because we have learned what are the causes which engender it, and are therefore better able to prevent its occurrence." —*Discussion on the Germ Theory of Disease, Pathological Society's Transactions*, Vol. xxvi, 1875.

ERRATA.

Page 3, last line in table of diseases—for "Chlosma" read *Chloasma.*

— 7, line 22—for "become absorbed," read *degenerated.*

— 10, line 7—for "dermis," read *derma.*

— 18—append to last paragraph quoted, the name of *Bence Jones.*

— 55, line 10—after "time," insert *by.*

— 68, line 6—for "eyes water," read *eye-waters.*

— 72, line 6—omit "a" before "fungoid;" and in line 7—for "growth" read *growths.*

— 101, line 19—after "this," insert *material;* line 20—after "lungs," insert *which when;* line 21—after "salts," insert *becomes effete matter.*

— 103, line 10—for "his," read *Professor Tyndall;* line 18—for "they," read *germs.*

— 104, line 23—for "That," read *A;* and after "of," read *fungus,* striking out the words, "disease in which fungus bodies are found."

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SKIN DISEASES

OF A

SUPPOSED PARASITIC ORIGIN.

"In organized nature everything is minute, nothing can be done by rapid generalizations of aspiring genius, which makes use of no instruments but words. But all things are effected by laborious, patient investigation, by the mechanical but important material apparatus of hands and eyes."—*Sir Humphrey Davy.*

THE aim of modern medicine seems to be directed, much more than formerly, towards making distinctions where none, when properly examined, are perceptible. This is not only embarrassing to the student in medicine, but is quite opposed to the views of physiologists who are strong in their conviction that all varieties should be reduced to uniformity.

The charge brought against modern medical practice in general is especially exemplified in the study of diseases of the skin; for it seems that certain dermatologists of repute have thought it right to split them up into endless varieties; thus determining this class of affections from the ordinary course, and apparently for no better reason than that of making it appear that cutaneous diseases are not to be treated upon those principles which guide us in the treatment of disease generally. It is therefore by no means surprising that the relation skin affections bear to pathology should have been very nearly overlooked in an anxiety to establish wide distinctions and over nice classifications.

The source which has hitherto furnished us with the indispensable elements for the study of this branch of medicine has also served to perpetuate erroneous views as to the nature of the diseases themselves; consequently an irrational empiricism as regards their treatment has taken the place of reasoning and ripened experience. The subject indeed has been too long abandoned to the specialised proclivities of the day, and it has therefore become almost a distinct branch of medicine having but little connexion with any other. The sound practitioner knows full well that the majority of cutaneous affections are symptomatic of other diseases; the outward manifestations, as it were, of some internal affection, or an accompanying symptom of a deteriorated state of health. I have made attempts to enforce these views upon the profession, but I fear without having accomplished all I could wish; my remarks have a special reference to the German theory of the vegetable origin of certain skin diseases propounded by Unger in 1833. This tempting theory was not long in attracting attention and finding supporters even among men of eminence, as Schönlein of Berlin, Gruby, Robin, Küchenmeister, &c.; and it derived some impetus from the circumstance that Professor Owen attributed the death of a Flamingo* to the ravages of a fungus found in the lungs of the bird. Not long afterwards, Bassi of Lodi demonstrated the vegetable character of a disease

* Owen, while dissecting a Flamingo, found the lungs filled with tubercles and vomicæ. "I was much struck," he writes, "with finding the inner surface of the latter cavities, and that of most of the smaller ramifications of the bronchial tubes, covered over with a green vegetable mould, or mucor. As the individual was examined within twenty-four hours after its death, it seemed reasonable to conclude this *mucor* had grown there during the lifetime of the animal. Thus it would appear that internal parasites are not exclusively derived from the animal kingdom, but that there are *Entophyta* as well as *Entozoa*."—*Zoological Society's Proceedings*, *Aug.* 28, 1832.

which caused great devastation among silkworms. M. Gruby subsequently announced the fungoid character of *mentagra* or sycosis; while numerous other observers attempted to identify several species of fungi with the diseases which they believed were produced by them. In this way it has come about that several of the most common skin affections have been separated and detached from the rest, and are now almost exclusively regarded as of a fungoid or parasitic origin. Thus, the parasite supposed to be peculiar to, and productive of, each disease, has been minutely described, and honoured with a name derived from the name of the disease which it is supposed to have originated, as appears in the following table:

Willan.	Bazin.	Wilson.	Parasite.
Porrigo favosa and lupinosa	Tinea favosa	Favus	*Achorion Schönleinii*
Porrigo scutulata	Tinea tonsurans	Trichoses furfuracea	*Trichophyton tonsurans*
Porrigo decalvans	Tinea decalvans	Alopecia	*Microsporon Audouini*
Mentagra	Tinea sycosa	Sycosis	*Microsporon mentagraophytes*
Pityriasis versicolor	Pitiriasis	Chlosma	*Microsporon furfur*

Now, this seductive theory not only involves, as I have intimated, an important principle of pathology, but it places the parasitic fungi above described in a category by themselves, and invests them with characteristics entirely at variance with those of the natural history of the family of fungi, whose leading feature appears to be that of selecting diseased and decayed structure as the soil most essential to their existence; whereas this hypothesis assigns to them healthy organized matter to live and prey upon, thereby establishing a specific disease. In examining into the truth or

fallacy of this theory by the light of physiology, we must bear in mind that the surface of the human body is supplied with a delicate covering, one office of which is to excrete, and another to eliminate or exude, effete matter from the blood. The excretion consists chiefly of epithelial scales, and the exudation is mostly made up of fluid and gaseous matters, which sometimes become condensed and dried on the surface of the epidermis. The epithelial scales are friable and separable by very slight friction during health, and the transpired fluid makes its escape, under ordinary circumstances, without any assistance from without. But want of cleanliness, deficient exercise, and more frequently a deranged state of the health, especially a vitiated condition of the body, interferes with the natural processes of elimination; and then the skin itself becomes diseased, and in this diseased condition may become infested by parasitic fungi, the spores and filamentous threads of which find a nidus in an abraded portion of the cuticle, the shafts and roots of the hairs are invaded, the hairs become brittle and stunted in growth, and at length perish and fall off.

While admitting the existence of certain parasitic fungi in connection with favus, porrigo, &c., it is sufficiently evident, after a careful study of the writings of Gruby, Bennett, and others, that they must be looked upon as a result, and not as a cause of disease; and it is important to remember that parasites are not even universally present in these affections. In the year 1856, I undertook, at the instigation of my friend, Mr. Hunt, an investigation into the nature and origin of the so-called parasitic diseases of the skin; and, without having formed any preconceived opinion upon the subject, and for the elucidation of particular points, I made in all a very large number of examinations of the products of cutaneous affections. The cases investigated

were chiefly derived from fourteen genera of Willan's classification; namely, Porrigo, Psoriasis, Pityriasis, Sycosis, Lepra, Lupus, Lichen, Impetigo, Furunculus, Eczema, Vitiligo, Spilus, Ichthyosis, and Acne. The spores or filaments of a cryptogamic plant were found in most of the genera. In four of the several diseases arranged under the heading of—1st, *Porrigo decalvans, Tinea decalvans, or Alopecia circumscripta;* 2nd, *Porrigo scutulata, Tinea tonsurans, or Herpes tonsurans;* 3rd, *Pityriasis versicolor, Pityriasis lutea, or Cloasma;* 4th, *Sycosis, or Mentagra*—in these special forms, previous observers had described fungoid growths; as also in *Porrigo favosa;* but in six or seven other well-known diseases—Psoriasis, Lepra, Lichen, Eczema (with or without Tinea tarsi), Spilus, and Ichthyosis, no writer had noticed the presence of fungi; and therefore they were always separately described, and considered free from vegetations; and they have accordingly not been placed in the class *Dermatophyta*, a name bestowed upon certain affections of the skin supposed to be of parasitic origin. The publication of my investigations in 1856, 57, and 58, attracted some attention; and many other observers took up the important question, and, upon a closer examination of my facts, came to the conclusion that diseases of the skin associated with vegetable growths were not exclusively due to the parasite; and although the growth might aggravate the disease, its true pathology was a degenerate condition of the blood, an arrest of the function of the skin.

In my remarks upon cutaneous diseases, I have adopted Willan's classification, as the simplest and best; for, in my opinion, old as it is, no modern arrangement can at all compare with it, or appears to be likely to displace it in the estimation of those who study skin diseases. Dr. Willan arranged affections of the skin under eight orders; that is, according to certain external

indications presented by the primary outbreak of the disease. These orders are as follows:—

Order 1. Papulæ (pimples).
2. Squamæ (scales).
3. Exanthema (rashes).
4. Bullæ (blisters).
5. Pustulæ (pustules).
6. Vesiculæ (vesicles).
7. Tuberculæ (tubercles).
8. Maculæ (spots).

This appears to be a rational classification, and one by means of which we are enabled to generalize skin affections, and submit them to an examination perfectly in accord with the pathology of the day.

Before I venture to speculate upon pathological changes, say what is the normal condition and what is a departure from the healthy state, whether of the cutaneous surface, or of the more deeper seated parts of the body, it is quite necessary that I should offer a few brief remarks on the minute anatomy, structural arrangement, and functions of the several parts with which I am about to deal. The literature of this part of the subject has grown enormously of late years, and therefore it is difficult to compress into a few terse sentences all that should be written on many points of value and interest. The physiological relation which the skin bears to the rest of the body, and to its healthy condition, is indeed a matter of considerable importance, especially as the state of the health in a great measure depends upon certain subsidiary functions which it is designed the cutaneous surface should assist in the performance of; namely, absorption, secretion, excretion, &c.

In every case, it must be remembered that, whether attention be given to the organisation of the animal or

vegetable kingdoms, a great similarity will appear in the mode of growth and repair going on, and contributing to, the increase of the several parts of the individual. Additions and repairs are made from within and extending outwards; each point or limb grows, or is added to, by an interstitial deposit of germinal matter, and not by the aggregation of particles externally brought into contact with the surface. In the animal body, much depends upon the perfection of its several parts, and nothing can long remain stagnant or out of health without endangering the safety of the fabric.

In man, who stands at the head of organised beings, are tissues differing greatly in constituency and density; from the fluids of the eye and the more consistent fatty matters beneath the skin, to the resisting muscles and denser bone; from the soft and fragile skin covering the body to the flinty enamel of the teeth; alike derived from cells. The same law of growth holds good with regard to all, whether fluids or solids; they constantly require renewing; the older particles, cells, entering into the several tissues, become absorbed or worn out, and thrown off from the body as effete matter; while new particles are or must be as rapidly formed to supply their place. Life, in short, is sustained by a constant abstraction of certain elements from the external world; whilst decay and death is a result produced by the using up of the same, and their return in one form or another to the source whence they were originally derived. Life is inseparably linked with change, the arrest of which is temporary death: nevertheless, it is only through incessant destruction and reconstruction that vital phenomona emerge—an ebb and flow of being.

"The ordinary oxidation that takes place in each texture of the body gives heat and motion sufficient to carry on the ordinary nutrition of the structure; but

the smallest increase of oxidation, set up by direct extra-vascular or indirect intra-vascular motion through the nerves, is followed by altered heat, motion, and nutrition. The effect of slow but continued per-oxidation may be constantly watched in the skin of the eye. The slightest long-continued mechanical pressure produces not only thickened cuticle, but altered nutrition of the skin itself. In the cornea, a chronic inflammation from some very slight mechanical cause will leave a thickening which may be perceptible for years."—(*B. Jones.*)

Unless a due amount of animal heat were maintained, it would be impossible to carry on the several functions of life, most of which are either impaired or altogether arrested by a very low temperature. Man is so constituted as to be able to resist the effects of considerable changes of temperature; nevertheless, nature has left him the least protected, physically considered, of any animal; his skin, being without external covering, demands on this account more care and attention. From this circumstance alone, the cutaneous surface is subject to frequent derangements. The sensible and insensible perspiration, breathing in fact, which is carried on through the skin, is of the highest importance to health, nay, even to life. If we cover the whole of the skin with an impermeable varnish, or enclose the greater part of the body in an air-tight case, the individual so treated dies in a few hours. The escape of the heat of the body through the skin takes place quite independently of the exhalation of the gaseous vapour; although this, together with the fluid perspiration, is, under ordinary circumstances, quite sufficient to regulate the temperature of the body. The use of artificial clothing, in regulating the temperature, acts by moderating and restraining the escape of caloric from the body; the warmer descriptions of clothing preventing the escape

of heat, the lighter favouring this; and it is upon this principle alone that articles of clothing appear to be warm or cold. I will merely add that the power possessed by the skin of controlling the excess of the temperature of the human body is manifest in hot seasons and in tropical climates, when, although the heat may reach several degrees beyond the temperature of the blood, it exerts no influence over the usual standard of the body, 97 deg. Farht. This power is still more manifest in the use of the Turkish bath, heated to 200 deg. or more, and which is borne by those accustomed to its use with a sense of comfort. The excess of heat is carried off by the increased secretion of the cutaneous perspiration, which absorbs the caloric in the formation of watery vapour, and is thus discharged from the body.

In many, if not in most diseases, the functions of the skin exercise a most important influence; too little regard is paid to this and the consequent advantanges to be obtained in their treatment by promoting its healthy action. It will be sufficient for my purpose at present if I enumerate the several *functions* of the skin, and which are fivefold, namely:—secretion or exudation, absorption, sense, sensibility, and as a storehouse of animal heat to sustain the temperature of the body. The several functions will be noticed somewhat more in detail in connection with the minute anatomy of the cutaneous covering.

The Anatomical Structure of the Skin.

The skin is composed of three layers, the epidermis, or cuticle, the dermis or true skin, and the subcutaneous cellular tissue. It is largely supplied with blood vessels, nerves, glands, and adipose tissue. Muscular fibres are found in the superficial layer of the dermis in close

connection with the hairs of the body. In some of the lower animals, as the cat tribe, mouse, &c. these muscles are arranged in bands about the nose, and they serve to erect the hairs and convert them into sensitive tactile organs.

Commencing with the deepest layer, and the most important, the *dermis* or corium as it is sometimes called, is not a plain surface, it exhibits elevations, with corresponding depressions almost throughout. The uppermost layer assumes the appearance of numerous conical eminences or vascular loops termed papillæ. The fat, adipose, and connective tissues, are situated in this layer; but where the skin is loose, or can be thrown into folds, as about the eyelids and over the joints, no fat is stored. No papillæ exist where the skin is furrowed, as in the palm of the hands, &c.; but they are very freely distributed to semi-moist parts, as the lips, gums, mouth, &c.; and to such parts they give a soft, smooth appearance. The sudoriferous glands are situated in this layer; they are small oval bodies with spiral tubes running up through the several layers of skin to the surface. The sweat-glands are very important, and it is computed that there are 3,528 in every square inch of the hand. The secretion from these glands constitutes the sensible and insensible perspiration; the former is that which appears on the surface, where it rests for a time and then drops off; the latter is that which passes off insensibly, or without notice, in the form of watery vapour. The average quantity excreted from the body in the twenty-four hours is estimated at from two and a half to five pounds: this of course varies with the temperature, time of year, &c. It is one of the most watery fluids of the body, leaving only about one per cent. of solid matter after evaporation. The perspiration contains sodium chloride, ammonium phosphates, and other organic

matters, largely mixed with epithelium scales and fatty matters, which impart at times a remarkably sour smell to the body.

The epidermis or cuticle, the outermost layer of the skin, is composed of several layers of flattened-out scales. It was thought that no well-defined limit existed between the dermis and epidermis, but this is only true during the earliest stages of existence. In very young children, the two structures are invariably continuous with each other; the most superficial portion of the dermis consisting of a homogeneous layer of plastic material, protoplasm, and fine granular matter. The mucous layer, *rete Malpighii*, is composed of granules that are enlarged or enlarging by the absorption of a definite proportion of the protoplasmic mass. These scales or cells, as they come nearer the surface layer, assume a flattened-out form, and are somewhat horny in character. This change appears to commence with a shrinking of the internal body, nucleus, which divides into spaces, vacuoles. Besides these cells there are others in the mucous layer that resemble the connective tissue cells of the dermis; these are small in size, and of a fusiform shape, each having in its interior one or more nuclei. This layer of cells no doubt plays an important part in cutaneous affections. The scales of the epidermis are incessantly thrown off from the surface of the body; and, should the process be in any way impeded or arrested, derangement of health or disease will assuredly follow. The fat tissue of the skin is necessarily an important structure; and although each fat-cell contains but a single globule of oily matter, it requires a complete network of capillary blood vessels to maintain and renew the supply. The fat-glands, although present in almost all parts of the body, are more numerous in those covered with hair; they are, however, entirely absent in the palms of the hand and soles of the feet.

The papillæ, or vascular loops, have medullary nerve fibres running into them, and which afterwards pass to the tactile corpuscles. The lymphatics of the skin are accompanied by one or two blood vessels throughout their whole course. I may here observe of the glandular structure situated in the eyelids, that it is more complex than the rest; the gland ducts there ramify about in all directions, for the purpose of preserving the healthy nature of the secretion that nourishes the hairs about the eyelids. Should these glands become inflamed, the ducts are obstructed, and a disease is produced, *tinea tarsi*, common enough among a certain class of people. This disease of the lids is accompanied by the formation of small pustules and scabs, and leads to destruction, falling out of the eyelashes.

In the Malpighian layer of the epidermis, the first series of cells is described as columnar in form, while the immediately superimposed layer is cubical in form, of a larger size, with a granular nucleus, in which nucleoli are visible. The superficial or horny layer of the epidermis is composed of flat polygonal tesselated scales, the nuclei of which have nearly disappeared. The colour of the skin, noticed in certain persons, and the deep brown of the negro, depends on the presence of coloured granules contained in the cells of the Malpighian layer. In addition to the nervous supply already mentioned, preparations of the skin, made by staining with a solution of the chloride of gold, demonstrate the presence of an abundant supply of non-medullary nerves, ending in free extremities, and which run between the cells of the mucous layer. The subcutaneous nerve trunks are made up of both medullary and non-medullary nerve fibres; these dip down into the deeper parts of the dermis, and there divide and sub-divide into several branches, for the purpose of accompanying the blood-vessels. It is in this part of the skin that the Pacinian

bodies, tactile corpuscles, are found; the finer nerves seem to terminate in these bodies; this doubtless explains their extreme sensitiveness. The nervous structure is one of great interest and importance to the Dermatologist. The sweat gland, as we have already seen, is scarcely a less important appendage of the skin. It usually presents a contorted knot-like body, with a spiral-shaped tube making its way through the dermal, the mucous, and epidermal layers. According to Krause, there are 2,736 sweat glands in every square inch in the palm of the hand, 2,685 on the sole of the foot, 1,490 on the back of the hand, 1,303 on the neck and forehead, 417 on the back and buttock. Those situated under the armpits cannot be exactly compared, as regards their number, with those of other parts of the body; but their size is very remarkable. Besides the various structures enumerated, there are the muscles of the skin, composed of both smooth and serrated fibres; the latter reach the skin from the deeper lying parts in the face, the beard, and nose, while the former, or smooth, are in immediate connection with the hair follicles. Many hairs possess two muscles; these split up and pass over the nearest sebaceous gland, partly encircling it. As the hairs are inserted obliquely in the skin, forming a moderately acute angle with the surface, and the muscular bundles lie in a plane of a corresponding obtuse angle, the muscular contraction must obviously cause the hair to become almost erect. The well known effect of goose skin is in the same way produced by muscular contraction. Beside the several layers enumerated, there is a basement membrane which has been always described as structureless, but by the aid of reagents this is seen to be cellular.

The hairs are next in importance of the cutaneous structures; these may be briefly described as cylindrical modifications of the epidermis, peculiar outgrowths

of the epithelial scales, having a hardened, vitreous or horny exterior. The hair scales overlap each other, and are compactly held together by a layer of connective tissue, that becomes firmer and more solidified when brought into immediate contact with the outer air. A hair consists of a *root*, a *shaft*, and a point. The portion of the shaft situated beneath the skin presents a bulbous enlargement, and here it is surrounded by a network of bloodvessels, nerves, fat, and sebaceous matters, all of which are necessary to maintain it in a healthy condition. The central portion of each hair is filled with a medulla, and this, together with the pigment granules contained in the outer cells, imparts the variety of colouring observed in animals provided with a thick hairy covering.

To be somewhat more precise in describing a hair, we observe that it is composed of several layers of connective tissue and epithelial cells; this is better seen on making a horizontal section of a small bundle of hairs, and submitting them to a magnifying power of about two hundred diameters. It is then noticed that the external layer of each hair appears to be serrated; this arises from the overlapping of the scales, one lying over the other as tiles on the roof of a house. That portion of the hair concealed beneath the skin, the root, is fixed in a peculiar fold or sac, the *hair-bulb*. It is scarcely right to call this part of the hair shaft bulbous, as the hair often terminates in a blunt point. The hair follicles vary a good deal in length; those in connection with the longest hairs—as of the head and beard—pass into the subcutaneous tissue, while in other parts of the body they extend only a very short distance. In every case a small conical network of bloodvessels surrounds the *hair-bulb*, and it is from this point that the growth of the hair proceeds; and here the elements of the cortical substance changes into horny scales, the more recently

formed epithelium being the deepest. The hair is formed, like the teeth, from a pulp enclosed in a follicle; when a hair is plucked from its follicle, it is found that the root-sheath adheres closely to it. The stem of the hair possesses a certain power of growth; indeed so highly organised is it, that it would be strange if it were not so; and this view receives confirmation in a disease called *Plica Polonicá*. The hairs in this affection are split up into fibres, and at a considerable distance from their bulbs a glutinous substance exudes which mats them together; nevertheless, they continue to grow.

The colour of the hair is sometimes suddenly changed, by some strong mental emotion, from black to white. One of the most remarkable cases of the kind on record is that of the Pere Lefevre, narrated in a recent trial.* The loss of pigment or colouring matter in the cortex and medullary substance produces grey hair; but this does not destroy its vitality. The permanent hairs increase to a certain length; and when the limit of growth is attained, the papillæ are no longer able to support their weight, and they then fall out; new hairs are, however, developed in their place. In human beings, a succession of new hair is continually taking place; but in the lower animals there is a periodical shedding and renewal of what forms an outer warm coat. The falling off of the hair arises from the circumstance that no new epithelial scales are formed, or the last formed receive no nervous supply, and are consequently drawn out into condensed elongated hair cells; while those shed during some deranged

* Pere Lefevre's account of this singular change, brought about in a single night, is as follows:—"I was in Spain when I heard the news of the death of my father. In the night I dreamt that I saw him killed before my eyes, and my emotion was so great that when I awoke my hair had turned quite white." This is a notable example of the influence exerted by the mind or nervous system on the health of the body.

state of the health are either not replaced, or, when replaced, the hairs are stunted and colourless. Baldness frequently depends upon a double cause—a diseased condition of the bulbs and surrounding connective tissue. In advanced age, loss of hair is no doubt the result of a deficient blood supply, and is more frequently constitutional than local. It has been observed again and again that persons whose circulation is languid, slow, or defective, become bald at a very early period of life. The arrest of development, diseased condition, here referred to, does not originate in structures beneath the surface of the skin, and apparently far removed from the attacks of vegetable parasitic growths. The fungi, in exceptional instances, do appear to penetrate the dermic structure. It has been discovered that a rare form of fungoid disease occurs among the native population of certain parts of India; but this is always confined to a foot or a hand, and never attacks any other part of the body.

I shall have occasion to revert to the fungus foot-disease more in detail further on. I proceed to consider the structural character of the nails. It is well known that the nails form a horny and somewhat transparent termination to the fingers and toes; they differ from hairs, inasmuch as, although very dense outgrowths of the epidermis, the epithelial cells spread out and array themselves in an imbricated manner, one layer leaving only a portion of the next uncovered, the last lying embedded in a fold of the skin, and forming a matrix beneath the surface. The nails, like the hairs, are composed of epithelial scales, connective tissue, dermis, and a mucous layer of the bed-matrix. The mound-like elevations of the matrix form a series of from fifty to ninety ridges, which are chiefly made up of parallel fibres of connective tissue and fusiform cells. The deepest layer of cells is columnar, and the blood-

vessels form a plexus, from which numerous vascular loops are sent off to supply the papillæ. The nerves lie embedded in the subcutaneous tissue of the nail-bed. Sections of nail, soaked in a potash solution for a short time, easily break up into numerous fragments well suited for an examination under a magnifying power of 300 diameters. The dense mass is then seen to be composed of numberless nucleated epidermic cells cemented together by connective tissue and albumen. When the nail-wall is deficient in structure, as frequently occurs with the little toes, the nail does not grow out, but, having increased in thickness and attained to a certain height, it breaks off. Irritation of the matrix, produced by pressure or other cause, is attended by inflammation and suppuration, and loss of the nail. New nail is formed by the matrix, so that this is a very important part of the structure; and even suppurative inflammation occurring in the nail-bed will not stop the growth of new nail. This fact constitutes another instance of the almost entire dependence of the dermal appendages upon the deeper-seated internal structures, and quite independent of external causes. Late researches prove that, in the earliest embryonic stage, the formative processes and changes begin with a division and splitting up of the same cells as those seen in the adult. The small round cells increase and multiply, and become transformed into various definite tissues, recognisable as skin, hair, glands, &c. up to the wonderfully perfect optical crystalline structure of the eye. These, together with the epithelial membranes of the nose, ear, &c. are all developed from one primary series of cells, and the order of development in the normal state never seems in any way to vary. This indicates an intimate relationship between the organs of sight, hearing, and the skin; hence the constant liability of these several parts to become simultaneously affected.

If this be so, how necessary it is to possess a perfect knowledge of the microscopical anatomy of the skin, and of the pathological processes which determine and maintain the human frame in a healthy state!

Who can rise from a study of the outer covering of the body, and say that when abnormal changes are observed in any part of it they belong to a distinct and separate nosological order? No one doubts that disease, whether of the external or internal parts of the body, must be considerably modified by the anatomical or structural arrangements in its own immediate locality. An eruption taking place on the surface of the body is but a manifestation of a pathological change in the organization generally, modified by the structure in which it makes itself apparent to the eye. It has been observed that although the quantative and qualitative errors of the chemical composition of the different structures of the body attract and demand much attention, nevertheless little is known of the causes on which these errors depend. "The excess or deficiency in the supply of nutritive material—the wrong quality and quantity of the matter supplied—the wrong chemistry, in the act of assimilation in the different textures—the excess or deficiency of chemical action in the removal by the used organs—these constitute a multitude of diseases; some of which are known as hypertrophy, atrophy, and degeneration; and most of which are only guessed at even at the present day."

As regards the pathological anatomy of the skin, it is believed, and with a good show of truth, that the varied forms of cutaneous affections are essentially of an inflammatory type, differing among themselves in intensity, and changing with the inflammation present and the part affected. Take eczema as an example. In this disease the papillæ are the chief seat of the affection; and in the earliest stage of the disease these bodies

increase in size, and contribute towards the exudation of a clear serous fluid. The connective tissue corpuscles become stimulated in their growth by the abundance of pabulum; these enlarge and multiply, and the resultant free cells migrate from the papilla and insinuate themselves between those of the mucous layer. Such cells present an elongated form, branch out towards the corneal layer of the epidermis, and there unite to form an irregular network with those of the mucous layer. Some anatomists look upon these especial cells as constituting a system of nutritive canals for the mucous-layer; and by their agency a larger quantity of serous fluid infiltrates the papilla, and is brought to the tissue, thus causing it to swell out even to bursting. The epidermis, in a somewhat similar manner, from irritation becomes separated as a minute blister, bursts, and ends in a running sore. It is further supposed that even pus cells, or pustules, filled with a serous fluid, do not proceed from the multiplication of the cells of the *rete mucosum*, or mucous layer, but are rather offsets from the spindle-shaped cells of the connective tissue and papilla, which, multiplying very rapidly, are forced to the surface.

Although it may appear that I have entered somewhat minutely into the anatomical and pathological relations of the skin, I believe it will be conceded, by those acquainted with the subject, that no one can cope satisfactorily with its morbid lesions unless he possess a perfect knowledge of the several parts with which he has to deal; neither is it possible to distinguish one disease from another without an acquaintance with secondary results. For this reason, it is often necessary to proceed by another and very generally adopted method; namely, by comparing the special characters of one form of disease with that of another, and by a process of elimination, arrive ultimately at a correct diagnosis.

If, for instance, the epidermis or cuticle presents a simple elevation with a clear transparent fluid, it may be safely inferred that the disease is neither an exanthem nor a variola. By another method we obtain a knowledge of the secondary products which form the basis of Willan's classification; and this may enable us to distinguish varieties—as an eczema from a herpes.

A simple view of the causes and morbific influences at work in the production of skin diseases, in almost every form of eruption, is exhibited in an intelligible tabular form by Mr. Hunt.* The only diseases men-

* *Tabular View of the Morbific Influences originating Cutaneous Diseases.*



tioned by Willan which are not included in Hunt's table are pompholyx, ephelis, spilus, and aphthæ. But as the first is only another name for pemphigus; ephelis a form of pityriasis; spilus a kind of nevus; and aphtha a parasitic growth occurring in the mouth during childhood; these may be eliminated.

Parasitic Diseases generally.

Before I fully enter upon the question of the so-called parasitic diseases of the skin, it is necessary to observe that I am about to reproduce the results of observation commenced in 1856, and extending over several years, to ascertain the nature, origin, and supposed influence exercised by certain minute vegetable organisms, which the microscope has enabled us to detect in connection with human skin affections. I may likewise add, at starting, that subsequent investigations tend to confirm the conclusion at that time come to, that fungi were not necessarily the *cause*, but more probably the effect, of the morbific condition. It is therefore more than ever necessary that attention should be steadily directed to the elucidation of this important question—whether the parasite be capable of originating a specific disease?—otherwise we may be liable to mistake the shadow for the substance. At the same time, I do not deny that the spores of a fungus may aggravate a condition of disease; that is, when an eruptive or abraded surface offers a favourable soil for the growth of a parasite, it takes root and flourishes: this is seen to occur among plants of unhealthy growth.

It is believed that there is a tendency among plants and animals to become affected by a parasitic growth; and this may be increased by atmospherical conditions, such as those known to favour the spread of an epidemic disease. I have observed, during the preva-

lence of a close, moist state of the atmosphere, that fungi abound; while in an opposite condition, fine, dry weather, or brisk, frosty weather, they quite disappear. This is not remarkable, as eggs and seeds lie dormant at such times and seasons, and many forms of vegetation, as the *protococcus*, grow only when the air is moist, and when dry remain perfectly quiescent. *Vibrio tritici*, wheat-cockle, can be kept inactive for years, and the powers of the cerebrum of birds suspended by freezing. It is not surprising, therefore, that diseases of the skin, accompanied by a parasitic growth, are rarely met with during certain states of the atmosphere. It is noticed also that seasons bring round with them especial outbursts of disease; and perhaps this is why we find the spores of *aspergillus*, *penicillium*, and *puccinia*, more widely distributed both in town and country towards the end of the hot weather; about autumn time they are everywhere more abundant. Among those who have taken them at this period of the year, I may name the Rev. Lord S. Godolphin Osborne, who, during the cholera visitation of 1858, exposed prepared slips of glass over cesspools, gully-holes, &c. near the dwellings of those suffering from the disease, and caught what he named *aërozoa*—minute germs and spores of fungi represented in fig. 1.* I have again and again amused myself by catching these floating atoms, which may be found everywhere, and in and on every conceivable thing. Even the open mouth is an excellent trap for them: of this there is ample evidence, since on the delicate membrane lining the mouth of the sucking, crying infant, and on the diphtheritic sore throat of the adult, the *Oïdium albicans* is

* Mr. Glaisher, during cholera epidemics, noticed the constant occurrence of a dense blue mist; slides exposed during the prevalence of this atmospheric phenomenon, and examined under a high power, exhibited numerous organic particles, fungi, &c.

often discovered. The human or animal stomach is also sometimes invaded: in a certain deranged condition, the *Sarcina ventriculi*, and its remarkable-looking quaternate spores, seriously interfere with the functions of digestion.

The same class of vegetable organism occur in connection with skin diseases. The whole genera belong to a division of acotyledonous plants, called by botanists *Thallophytes* and *Cellulares;* plants composed of cellular tissue only, having neither stem, leaves, nor stomata, and reproduced by spores; in fact, the lowest forms of vegetable life, which alike, from their extreme simplicity of structure, puzzle the botanist and zoologist. The fungi mostly appear as a thallus, supported upon a fine thread, with spores or seeds on the under surface of the hymenium. By far the greater part of them live in the air, a few in water, always mysteriously making their appearance upon the surface of decaying organic matter. They are very fugacious, springing up in a night, arriving at maturity by noontide, and disappearing magically. I must briefly describe one or two of the commonest of the fungi, better known as moulds, or mildews. The simplest in form and structure is the yeast plant (see fig. 2), which, in its most perfect condition, is made up of globular vesicles, measuring, when fully grown, about the $\frac{1}{2500}$th of an inch in diameter. The older cells are filled with protoplasmic granular, nucleated matter; the nucleus rapidly increases, and nearly fills the parent cell, which then becomes ovoid; ultimately young cells bud out and are separated from the parent. Sometimes other and smaller cells are formed within the young one before it leaves the parent globule. This process is incessantly repeated, that is, so long as a supply of food lasts. The vesicles, it appears, derive their nourishment by a process of osmose, sucking in, as it were, certain portions of the organic fluid, and chemically decomposing it; appropriating a part of its nitrogen, and

giving off carbonic acid. If, however, it is placed in any adverse condition, it becomes surrounded by a layer of condensed matter, resulting from the death of the germinal material, and ultimately a trace only of life remains, which, dying, takes the form of an impalpable powder, and is driven hither and thither with every breath of air.

I am justified in saying that there appears to be a difference in the results obtained by brewer's yeast and those obtained by penicillium. I cannot, however, agree with M. Pasteur that the different fermentations, the vinous, the lactous, and the acetous, are produced by different species of fungi; nor have I discovered that brewer's yeast belongs to another genus, although it may be a different species. The difference observed is that the brewer's yeast cell is quite circular in form, pale in colour, the cell wall is thin, and its contour not so well marked; it is filled with a granular matter, described as nuclei, varying in number from five to ten, and as soon as the solution becomes exhausted, the cell wall is ruptured, and the granular matter escapes, when, if fermentation is not soon stopped, bacterium-like bodies, vibrios, are produced, and acetous fermentation begins. In the other kind of cell, by far the more important of the two, the cell wall is thick, and its contour well marked, the interior is filled with a highly refractive protoplasmic mass, the central nucleus is faintly seen, at times is not made out until the solution is nearly exhausted, when the cell has a tendency to become ovoid in form, and sometimes considerably elongated. The cell in its early life is precisely like the German yeast cell, and which is mysteriously developed. It is doubtless identical with the fungus found floating in the air; and when it germinates in vinous solutions, it grows to a much larger size; under certain conditions it bears a resemblance to the fat corpuscle, and probably has been mistaken for

it. I term this the albuminoid form of cell, because the presence of albumen seems to add to the vigour of its growth. But the most remarkable fact in connection with this fungus is that it produces ten per cent. more alcohol than its congener, and does not become so readily exhausted as brewer's yeast. It is impossible for me to offer any explanation of this fact; the spores must float about in an almost impalpable dust, and it does appear that a dry powder, equally with an extract of yeast, is all that is necessary to bring about a transformation of sugar into alcohol.*

It is curious also to notice that, with the exhaustion of the glucose, levulose, or dextrose, the development of vibrios or bacterium-like bodies occurs, at the same time the lactic acid change begins, and a destructive process ensues. The cell walls appear to supply food for these low forms of organisms, which ultimately die off, and are succeeded by other generations. A large quantity of albumen seems to be produced by the contact action of these aërozoa; but if this substance is greatly in excess, the solution is more prone to a destructive ferment, especially so if cellulose be present at the same time. A remarkable instance of this has been brought to light. The Batrachospermeæ are algæ, living in a sort of albuminous envelope, and their zoospores are

* Liebig's latest investigations were nearly conclusive that the yeast fungus (*Cerevisia torulæ*), if it plays any part, it is a very unimportant one, in the process of fermentation, or the transformation of glucose into alcohol and carbonic acid. This great chemist considered fermentation to be a purely chemical or physio-chemical process brought about by heat. "It is possible," says Liebig, "that the physiological process stands in no other relation to the process of fermentation than that, by means of it, a substance is formed in the living cell, which, by an action peculiar to itself (resembling that of emulsin), determines the decomposition of sugar and other organic atoms. In such case, the physiological action would be necessary for the production of this substance, but would be otherwise unconnected with the fermentation properly so called."

aggregated in cells. On placing masses of this algæ in a bottle, and adding fresh water, a spontaneous ferment is soon set up, the seed-vessels burst with the disengagement of gas; after this operation the colour of the liquid changes; it assumes a delicate pink in direct light, which deepens to a reddish hue in condensed light; the fluid is now dichroic, it is fluorescent, and the spectroscopic appearance is one of interest: the spectrum is a well-marked one, and may ultimately assist in determining the presence of albumen in animal and vegetable solutions. It certainly appears that the physiological action set up in fluids, having an excess of albumen present, is one which differs considerably from the chemical changes observed under other conditions.

Dr. Thudichum revived a curious experiment—the immediate conversion of cane sugar into grape sugar. If we take two parts of white sugar, and rub it up in a mortar, with one part of a perfectly dry solid—the so-called German yeast—it is transformed, as if by magic, into a flowing liquid mass—a syrup. This process of forming "invert sugar" can be watched under the microscope; the liberation of carbonic acid gas in large bubbles is seen to go on, simultaneously with the assimilation of the dextrose, and breaking up of the crystals of sugar; the cell increases in size, as well as in refractive power; a remarkable state of activity appears in the minute mass, which is very interesting. German yeast is a spontaneously fermented mixture of wheaten flour, or malt and water, or honey and malt. I believe, with Dr. Thudichum, that this experiment goes a long way towards "changing our view of the action of yeast in producing fermentation." The transformation is so instantaneous, "that it partakes of the nature of those actions which in chemistry are called 'contact actions.'" The amount of moisture retained in the German yeast is very nearly inappreciable; yet it must be supposed

that there is a minute quantity retained, or the change would not be so very instantaneous. Is, then, the change—fermentation, as we call it—brought about by simple "contact action," or is it due to organic life?

It will be seen on reference to the figures given in my frontispiece, and as I shall presently proceed to show in an experimental and I trust a satisfactory way, that the same species of fungus frequently exhibits varieties of character, as well as form, at different stages of development and under varied influences; so much so, "that neither size nor outline affords any basis for distinction into species until it has been ascertained, from extensive comparison of forms brought from different localities in the widest area over which the species can be traced, what are the average characters of the type, and what their range of variation." Dr. Bary, and also Tulasne, established the fact of a wide-spread polymorphism among fungi. One fungus is actually known to possess six different kinds of fructification, the *uredo* itself exhibits four, and formerly these were described as distinct species.

Extreme simplicity of structure characterises all fungi or mildews. Their reproductive organs are somewhat more complex, but less understood; and although at first sight there is a difference in the appearances presented by their fruits, yet this is not sufficient to form a basis for classification. Both in penicillium, (fig. 5), and aspergillus, the mycelium terminates in a club-shaped head, bearing upon it smaller filaments with bead-like bodies attached to the apex, piled one upon the other, or, more properly speaking, *strung* together; these small bodies are termed *conidia;* others again are surmounted by larger spores of a discoid shape, some filled with granular matter, and others quite empty (fig. 5*a*). Those of aspergillus are mostly without granular matter or nucleated bodies, and are

more highly refractive. The club-shaped Puccinia is the well-known *smut* or *rust*, the very rapid growth of the spores and spawn of which appear to exert an exhaustive action over the tissues of the diseased cereal on which it feeds.

On repeating experiments made during my investigations "On the Vegetable Parasites of the Human Skin," I find little difference, either in the action or results produced in sugar solutions, between yeast fungus, favus fungus, aspergillium spores, and those spontaneously produced in the sweet-wort; they are equally capable of converting or changing levulose and dextrose into alcohol; the chemical change is very nearly identical in either case, and the slight differences observed depend more upon the pabulum on which the spores are fed, than upon any other circumstances. Most clearly, diversity in form depends upon food, temperature, &c.; and whether the fungus is grown upon a sickly plant, an animal tissue, or a saccharine and albuminoid solution.

Nevertheless, it is attempted to build up a theory of diseases of the skin under a class termed *Dermatophyta*, as a something *sui generis*, and quite regardless of the fact that these lowly-organized plants are thereby invested with characteristics utterly at variance with the well-known peculiarities of the family of fungi.

My inquiry then resolves itself into a definite one, namely: Is the diseased condition of the cutaneous surface due to the ravages of a vegetable parasite? or is the appearance of the vegetation the result of disease? This is a question upon which I propose to enter, and undoubtedly it is one of some practical importance; for if the disease is produced by the parasite, we have only to destroy the latter and a cure is certain to follow. If, on the other hand, the parasite only acts the part of a scavenger, the province of which is to

remove *materies morbi*, then we must seek to rectify the condition on which the disease depends, and the parasite will be starved and disappear for lack of food. Every one knows that decaying substances are the seat of fungoid life; that the mould that infests the stores of the thrifty housekeeper, and the fungi growing in damp and rotting wood, are illustrations of this fact. These low forms of vegetable life exist on decaying matter; the decomposing process is their food, and becomes an organizing process in them; the force arising from the decomposition becomes and is their vital force. The life of the wood has in short been transformed into the fungus. The force has changed its form; but it is the same force in both. The fungus could not have grown if the wood had not decayed.

It scarcely admits of a doubt that all the diseases observed of late in our vines, fruits, and growing crops, are the result of some atmospheric condition, as well as an exhaustion of the plant or seed—a want of vigour arising out of loss of chemical elements in the soil and the air it breathes, which predisposes the plant to become an easy prey to "the murrain" or the fungus.* The microscopic germs of these lowly-organized vegetations are produced in millions; invisible though they be to the unaided vision, they make their presence known only when seen in myriads upon the earth, in the air, and water. Wonderfully minute are their spores, and equally wonderful their rapidity of germination and growth. The old sawn stump of a tree, after a warm and rainy night in autumn, is found covered with large agarics on the following morning. A spotless meadow

* "The potato, the vine, the hop, the elm, suffer; and aphides, scolyti, fungi, and other parasites abound. Without denying to these some effect, the facts show that the prime cause is the weakness of the nutritive forces of the individual, and that the parasitic animals and vegetables are the accident."—*Dr. Morris.*

has been known to be covered within forty-eight hours with puff-balls, many of which are as large as the human head; and a snow-covered country changed in a night to a deep red colour, by the *protococcus nivalis*, gory-dew, or red snow of the northern regions.

It will not be denied that the universality of distribution of the fungi is in itself a fact of considerable importance, and one pointing to the belief that they are ordained to become scavengers, ready to fasten on the disintegrating particles of organized matter destroyed by disease and undergoing the chemistry of re-construction by death. A very special purpose have these minute bodies to fulfil in the economy of nature: when any animal or vegetable body sinks below the standard necessary to maintain it in tolerable vigour, fungi fix themselves upon it, and, finding a suitable soil, grow and spread out their pellucid filaments in every direction and in dense masses, and in so persistent a manner as to arrest any further act of development.

In a similar way the epidermic structures of the human body may be entirely excluded by a fungoid growth from the salutary influences exerted by air and light, and prevented from giving out, exhaling, the accumulated carbonic acid, and in this way aggravate and hasten on a destructive form of disease. Such a mode of progression in the low forms of vegetation is actually seen to occur when the vine is attacked by the oïdium, a fungus described by botanists as a perfect plant, but which really is an imperfect condition of one of a more complex nature. The spores fasten themselves to the outer coat of the young grape, and, although internal development may proceed for a time, the sphacelated epidermis can no longer expand, and either bursts in growth, or further development is so entirely arrested that it withers and dies. This kind of arrest and death is known to take place when a silkworm is fed on un-

wholesome food, or is improperly exposed to wet or damp without sunlight; it then falls a victim to the dreaded *muscardine.* Animals having the highest and most perfect organization speedily succumb to similar deteriorating influences; there is no immunity when nature's laws are infringed or disregarded.

Seeing, then, that the fungi are characterised throughout nature by feeding on effete or decayed matter; that fungi supposed to be peculiar to certain diseases of the skin are also found in many other diseases of the cutaneous surface; that competent observers have not been able to find them in these peculiar diseases; that sporules and filaments, described as the cause of one definite disease, have been found in the products of another form of disease supposed to have a peculiar and distinct parasite of its own; and that attempts to implant these parasites in a healthy skin have almost invariably failed; one cannot but conclude that special parasites, peculiar to and productive of special diseases, *do not exist.* This opinion gathers strength from the therapeutical fact that the alleged parasitical affections are rarely, if ever, cured by destroying the parasite; while they *can* be cured by the due administration of appropriate alternatives and tonics, which are capable of correcting the blood dyscrasia, which, in truth, originates the disease.*

Various Opinions on Parasitic Diseases of the Skin.

Very considerable differences of opinion exist among authorities on skin diseases as to the part played in certain cutaneous affections by vegetable organism. Professor Bennett of Edinburgh agrees in the main with

* "British Medical Journal," No. cxvii, March 26, 1859: "The Vegetable Parasites of the Human Skin." By the Author.

the views I have expressed. He maintains that the parasitic growth is a secondary matter found in a living animal previously the subject of deranged health. Dr. Tilbury Fox expresses similar views, and says that the fungus should be regarded as a something superadded to the diseased condition. "A complex condition, an eruptive disease plus a tinea" (parasite). In other words, "the pathognomonic sign of a parasite disease of the surface is the infiltration and destruction of the hairs by the spores; and the diagnosis can in no wise be considered perfect until spores or mycelia have been detected by the microscope." I do not quite agree with this definition of the diseased condition, nor can I admit that the growth of a fungus is necessarily pathognomonic of any special form of disease. Other observers of eminence go much further than this, and hold that the fungus is solely the cause of the disease; and, proceeding on this theory, as I have already observed, give a generic name to each fungus—a name derived from the character of the disease and signalizing the species. Sir William Jenner at one time adopted similar views, and taught that the simple way to cure these peculiar affections was to destroy the fungus by some topical application; but the error soon betrayed itself to his mind, and he candidly acknowledged that this mode of treating skin diseases ended in disappointment and failure.

Küchenmeister concludes: "that these microscopic discoveries explain not only the pertinacity of the disease —since it is well known that the lowest plants develope themselves most intensely and rapidly in a favourable medium—but also its contagious character, which is no longer doubtful. The fungus itself is the sole cause of these changes of the hair, and of the secondary irritation and congestion of the skin, which cause exudation, an accelerated formation of the epidermis, scaling off and

production of crust, because the swollen hair exerts pressure on the skin."*

I may here once more remark that it is scarcely possible to show that these microscopic germs are in any way the cause of any special form of disease, although I can go further than Küchenmeister and most observers, in having discovered fungoid bodies in connection with a larger number of chronic skin diseases, and in some of which it was not before supposed they had an existence. Thus, out of twenty cases and upwards of lepra and psoriasis, evidences of a fungoid growth were seen in half of them. The same was noticed in two out of three cases of lichen; in four out of six of eczema, etc. Other competent observers, however, have not been able to discover them in the diseases thought to be engendered by vegetations. Malherba, Wilson, and Cazenave, doubt the existence of a vegetable fungus in porrigo scutulata (the common ringworm); or if, as Professor Wilson observes, the cryptogam should be formed, "I by no means admit that it is the origin of the disease: it is rather a secondary or adventitious product." The same remarks apply to the presence of *achorion Schönleinii* in connection with favus, and also *microsporon andonini* in porrigo decalvans. It is not denied that fungoid growths do occur in connection with certain forms of skin disease; but that they are surrounded by special characters, and afford a basis for classification, is utterly untenable. Thus, in a case of porrigo which occurred in a girl 16 years of age, ill-nourished, neglected, and dirty, I found no porriginous variety of fungus but one, described by Robin and Küchenmeister as peculiar to plica Polonica, a disease almost unknown in this country. Again, in a case of

* Küchenmeister's "Manual of Parasites," p. 144. Sydenham Society's translation.

tinea tarsi, I found spores of the fungus described by Ardsten as *puccinia favi*—spores represented in fig. 1. Robin also discovered, in some cases of favus, puccinia, together with achorion schönleinii. The latter were mixed up as a constituent of the crusts, while the former appeared to be superadded during the desquamation of the epidermic scales. Some observers have, in consequence of this, taken the achorion to be the spermagonial form of the puccinia. It has been also broadly asserted that the several morbid conditions observed in chronic diseases of the skin are mutually convertible, the one into the other; and therefore that lichen, eczema, impetigo, psoriasis, and lepra, are only modifications of one and the same form of disease; that variety is but an accidental modification, produced by constitutional causes; and dermatologists themselves seem to favour this idea, by assigning names to certain diseases which are indicative of a mixed character—as eczema *impetiginodes*, eczema *leproides*, lichen *urticatus*, erythema *papulatum*, and so on.*

It will be said, no doubt, that many of the cases

* Dr. H. S. Purdon has seen herpes circinatus and favus occur at the same time. Upon examining the back of a fever patient 18 years old, he found several patches of herpes circinatus, and which she stated had existed for nearly three years. In the middle of the patches a circular spot of favus was noticed, about the size of a penny; this was recent. During the progress of the case it was interesting to observe the action of the fever, so to speak, upon the eruption; the patches of herpes all but disappeared, and the favus became dry and of a whitish colour, losing its sulphur-coloured appearance. As soon as convalescence was established, little vesicles showed themselves around the margins of the eruption, and which rapidly assumed a spreading character. This is the third case in which Dr. Purdon has observed the occurrence of favus and herpes circinatus in the same subject, showing the identity of the fungus, which, in a more matured form, allows of the development of fungus. The secretions, he tells us, are usually acid in patients in which vegetable parasites appear; and hence their greater frequency in the strumous diathesis.

examined by me belonged to this category, and therefore the finding of parasitic fungi in connection with them, might, *à priori*, have been expected. My first batch of cases were selected under the practised eye of my friend Mr. Hunt, and were taken as typical of the forms of disease under which they are enumerated and described.

A word or two on the mode of examination adopted. Each specimen, soon after removal from the body, was submitted to a microscopical examination; and, in order to avoid errors of interpretation, it was likewise subjected to the action of various reagents—the drawings being made under a power varying from two to four hundred diameters, by an independent observer, one accustomed to work of the kind. In my description of the several skin affections examined, it is not my intention to adhere to any particular order or classification of diseases. I shall rather take them in their order of importance in connection with the parasitic said to originate them; and on the continent, where this theory first found favour, favus occupies the post of honour.

Porrigo Favosa.

Porrigo favosa. Syn. Favus; porrigo lupinosa; *favus dispersus; honey-comb scall.* (Achorion Schönleinii, figs. 6 and 7.)

Under the name of porrigo lupinosa Willan and Bateman describe a peculiar form of disease rarely seen in this country, while on the continent, where it is more common, the affection has received the name of favus. During a long period of attendance at the Dispensary for Skin Diseases, I saw only three cases of this affection, and from all I was fortunate enough to obtain a good supply

of scales. It is admitted that favus is essentially a disease arising out of misery; indeed it is rarely seen except in persons broken down in health, badly fed, or suffering privation, and living in dirt and poverty. Various theories have been broached of the pathology of favus, some believing it to be primarily a pustular affection, while others say it is a morbid secretion of the sebaceous glands, a tubercular modification of tubercle in the lungs, and so on, while more recently its vegetable nature and origin is insisted upon. Professor Bennett writes, "I believe that the pathology of favus is best understood by considering it essentially to be a form of abnormal nutrition, with exudation of a matter analagous to, if not identical with, that of tubercle, which constitutes a soil for the germination of cryptogamic plants, the presence of which is pathognomonic of the disease. Hence is explained the frequency of its occurrence in scrofulous persons, among cachectic or ill-fed children, and the impossibility of incubating the disease in healthy tissues, or the necessity for their being scaly, pustular, and vesicular eruptions on the integuments previous to contagion. But assuming the possibility of inoculation in healthy persons, it follows that the material in which the vegetations grow may, at the commencement, in a molecular exudation, be formed primarily or secondarily. That is, there may be want of vital power from the first, as occurs in scrofulous cases; or there may have been production of cell forms, such as those of pus or epidermis, which, when disintegrated and reduced to a like molecular and granular material, secondarily constitute the necessary ground from which the parasite derives its nourishment, and in which it grows."* Professor Erasmus Wilson, who has often

* Principles and Practice of Medicine, page 807.

examined favus crusts, is opposed to the notion that the disease owes its essential characters to a vegetable growth; he considers that the tubular and ovoid bodies are mere modifications of epidermic cells, which in some cases are actually converted into pus-globules. His words are, "the favus matter is produced from the development of the nuclei of pus-cells; the parasite is not a vegetable; or, if it be, it might be looked upon as an example of the conversion of an animal into a vegetable product." In his opinion these bodies are a mere resemblance to a vegetable formation, and consequently the statement of the origin of the vegetable formation by roots implanted in the cortex of the crust is unfounded, and the secondary cells (sporules) bear no analogy to sporules or seeds; and it is therefore unreasonable to assign to an organism so simple as a cell the production of seeds, and reproduction thereby, when each cell is endowed with a separate life, and separate power of reproduction.

The vegetable nature of the growths, and their analogy to other well-known fungi, as the *penicillium glaucum*, or *aspergillus penicillatus*, is beyond dispute; but as to the possibility of growing the fungus spores on the healthy human skin I have considerable doubts. I have followed Remark's experiments, and made attempts to inoculate the skin of healthy persons without success. In certain unhealthy conditions, and where there is an already abraded skin to experiment upon, fungoid spores may be made to germinate. In the one or two almost isolated instances of a success in this direction, it appears that crusts were bound on to an irritated part of the skin, or where pustules of some kind already existed, and after a period of incubation the disease has been established. It is stated that an acid state of the secretions, or some chemical change going on in the skin, is an essential element in such experiments.

Favus consists of an exudation from the cutaneous surface in which fungoid elements are found. The disease has been variously described, and under the several names of porrigo favosa (favus, a honey-comb), porrigo lupinosa (lupinum, the lupine), trichosis lupinosa, and tinea favosa. The affection first shows itself as round isolated spots of a bright yellow colour, which present a certain resemblance to the lupine seeds; these run together and form crusts of an hexagonal, honey-comb shape. The formation of pustules is not an essential of the disease, and therefore it is a mistake to classify favus among pustulæ (Bennett). These, however, do occasionally appear as a secondary result, and when desquamation of the cuticle is rapidly taking place. In the few cases I have seen, the disease had fairly established itself, and the skin was quite of a pale colour, and without any increased vascularity; while the desquamation of scales was extremely large, amounting in weight from four to six ounces daily. In one case the scales were more disseminated, and formed a thick mass; the crusts were almost entirely composed of fungoid filaments, epithelial scales, and broken hairs. The fungus having fairly established itself on one part, it rapidly spread over the whole of the surface of the body, the palms of the hands and soles of the feet forming the only exceptions. The hairs were shriveled, and without colouring matter, and most of the surface entirely bald.

The constitutional symptoms are marked in most cases; and a deranged state of health is associated with enlarged lymphatic glands of the neck, or of the mesentery, and lung mischief. If the disease does not soon yield to tonics or good food, the skin assumes a mealy look, the crusts spread with increased irritation, and emit a disagreeable odour not unlike the smell of mice, and from this circumstance it derives the name of favus.

The surface becoming almost denuded of hair is explained in this way:—The shaft of the hair consists of hardened, shrunken, epithelial cells, almost devoid of germinal matter; and being removed some distance from the bulb with a weakened vital power, is less able to resist the parasite, which gradually cuts off nutrition, and ultimately destroys vitality. In this case, the fungus feeds upon the dying and the dead, and not upon healthy material.

If we take a crust and carefully examine it, we shall find that it is comprised of an outer and older part, thick and dark in colour; the fungus is here in a more advanced stage of growth, and consists of sporangia, spores, and mycelia, with fragments of hairs and pus-like bodies, while the inner or younger layer is paler in colour, and consists of spores with epithelium, fatty, granular, and purulent matter.

M. Gruby, who first described the microscopical appearances of the favus crust, gives the following direction for preparing specimens for examination under the microscope. Cut a thin section of the crust or capsule quite through, making it embrace the outer layer of the epidermis, amorphous mass, and light friable matter in the centre. This, under a power of 300 diameters, will be seen to consist of cylindrical tubes (*thalli*) springing from the sides of the capsule, and giving off branches dichotomously; when fully developed, they terminate in mycelia and a large number of round or oval spores (*sporidia*). The sides of the threads or tubes varies from the 1-400 to 500 of a millimetre in thickness, and they are jointed at irregular intervals. The mycelia and sporules agglomerated in masses are always more abundant and fully developed in the centre of the crust, while the thalli are more numerous near the external layer. The hairs which pass through the centre of the favus crusts are occasionally healthy, but more fre-

quently they are brittle and covered with threads and spores, which produce atrophy of their bulbs and subsequent baldness.

The physical aspect of persons suffering from favus is very remarkable; because, as I have already stated, this disease is the embodiment, or rather the impersonification, of a weakly, unhealthy state of the body, called by some a scrofulous habit; and associated with dirt and neglect. Hebra, the great authority on skin diseases, lays much stress upon the feature of *dirtiness* as a cause of favus, and observes that this accounts for its rarity among the upper classes of society. The subject of one of the worst cases I have yet seen was a puny, half-starved boy of seventeen, whose appearance was that of a child of nine or ten. When taken from his miserable home into purer air, and well fed, the crusts soon began to die and drop off; but when he returned to his wretched home, situated in one of the filthiest parts of Lambeth, and was insufficiently fed, the vegetation grew again most rapidly—"flourishing in the vitiated fluids like a vine in a mass of stercoraceous mould." From this boy I obtained, in 1859, large supplies of the fungous crusts, and with which I proceeded to make experiments which quite satisfied me that the favus spores, when added to barley-wort, produce as good a ferment as healthy yeast, with only a slight difference of size, "a difference of degree, and not of kind." Other experiments were subsequently made for the purpose of observing the influence exercised by light upon fermentation; and also in what way this agent affected the character of the results. I was, in a measure, led to make these observations from knowing that yeast requires for its more perfect growth, not only a proper temperature, but almost occlusion from daylight—a fact that appears to hold good with regard to the development and growth of most fungi. Having procured a supply

of fresh wort from a brewery, I divided it into three equal portions, and, for the sake of convenience, numbered them 1, 2, and 3. Into Nos. 1 and 2 I put a few favus crusts; No. 1 was put carefully away in a darkened place, the temperature of which was 70° Fahr.; Nos. 2 and 3 (the latter being simply sweetwort only) I exposed to a good light in my sitting-room window, the temperature of which ranges from 65° to 70° Fahr.; each bottle was closely corked. On the second day, upon examining a portion of 1 and 2 with a ¼-inch power, I found fermentation had commenced, a film having spread over the whole surface of the liquid. In No. 1 were seen a fair quantity of yeast-cells, varying in form and size. No. 2 was in a more advanced stage, and some of the spores were rather larger than in No. 1. On the 4th and 5th days I took portions from all three bottles. That from No. 1 gave the best results; the yeast-cells were more numerous and spherical in form, well filled with granular matter and numerous moniliform chains of smaller spores and amorphous stroma. Compared, however, with a small portion of fresh yeast from a beer barrel, the cells and spores appeared to be about half the size. In specimen No. 2 the spherical cells were fewer and smaller, with groups of ovoid spores mixed with torulæ, and bacterium-like bodies floating rapidly about; here and there were seen tufts of penicillium. In specimen No. 3 were numerous ovoid spores without granular matter, highly refractive, and not unlike fat globules.

On the tenth day the changes seen in specimens taken from each bottle were more marked. In No. 1 the spores were more numerous, but certainly smaller, and variable in form, and the greater portion of them were filled with granular or nucleated matter; there were also groups of torulæ mixed with smaller spores (see fig. 6). This specimen, when the cork was removed from

the bottle, gave indications of the presence of carbonic acid, the odour was that of good fresh beer, and the greater portion of the heavy yeast had fallen to the bottom of the bottle. No. 2, on the contrary, had become of a dark colour, smelt sour, and the spores had diminished in size, granular matter and bacteria being more numerous. The wort in No. 3 was still sweet—of a somewhat vinous sweetness—and the top was thickly covered over by a whitish, flocculent, filamentous-looking mass of penicillium.

A fortnight or rather more elapsed, and another examination gave somewhat similar results. No. 1 was still perfectly sweet, while No. 2 was more sour, and of a dark red colour; the filamentous masses were broken up, and had fallen to the bottom of the fluid, and the surface was slightly covered with a mould. No. 3, although smelling somewhat like bad wine, was not much altered in colour, and on its surface aspergillus was growing (fig. 7). Six months later, No. 1 was perfectly sweet, exhibiting well-marked spores and torulæ; No. 2 was rather more decomposed than it was on the former examination; No. 3 remained in the same state.

Upon comparing the fermentation of the achorion fungus with that of good healthy yeast, it was almost identical, and the influence exercised by light and temperature was marked; the difference in the size of the spores or cells was slight, the yeast cells being somewhat larger and more nearly spherical, with a greater number of reproductive spores, but having only a slight tendency to coalesce or become filamentous, while the favus ferment produced a greater number of ovoid cells, with a proneness to coalesce and bud out into torulæ. With reference to the slight difference in size, we may look upon this as a matter of little importance; for to the presence of light in the one case, and its almost total exclusion in the other, this difference, I have no doubt,

was almost entirely due. It would be more trustworthy if comparisons of this kind could be made at the same stage of development; for be it remembered that yeast obtained from a brewery is in a more favourable state for experiment, inasmuch as it is stopped at a certain stage of growth or development, and then *set* to begin its fermentation over again in fresh supplies of a new wort or pabulum, which gives increased health and vigour to the plant; whereas the favus fungus is obtained and used in an exhausted state, and taken from an ill-nourished or starved soil. Neither must we attach much importance to differences in size and form of the spores, as this also occurs in yeast ferment; the ovoid form, although most frequently seen in achorion, is equally common to yeast when exhausted. To ensure success in these and similar experiments, the fungus or yeast should be left floating on the surface of liquids; fermentation is either carried on very slowly or is entirely arrested by *submersion.*

Turpin and others, experimenting with yeast, noticed in every case that the cells become oval and bud out in about an hour after being added to the wort; this however quite depends upon temperature and density of solution, as well as upon the quality of the yeast. It is a fact that when yeast is added to distillery wash, which is always worked at a higher temperature than brewers' wort, fermentation commences earlier, and the yeast-cells grow to a much larger size. It is in this way forced much as a plant in a hothouse is, and obtains to greater perfection in a shorter time; but if again used as a ferment it is sooner exhausted, and therefore, if a small portion of this yeast be added to barley-wort and kept at a temperature of from 60° to 65° Fahr., it ferments languidly, and small yeast-cells are the result. If the yeast is allowed to stand in a warm place for a few days, it partially recovers its activity, never wholly. With such

a yeast there is always a good deal of torulæ mixed with the germinating cells, and sometimes a filamentous mass that falls to the bottom of the vessel; in this condition it readily passes to *must* and *mildew*, and then becomes a wasteful feeder or destroyer.

In other experiments, I took portions of *penicillium* and *aspergillus* moulds; upon adding these to sweet wort, I obtained results confirmatory of Dr. Lowe's,* and which were as follows:—Having placed the spores in the wort, I stood them by in a warm room for observation. On the second day in one of the solutions, and on the third in the other, fermentation had fairly set in; the surface of the solution was covered over with a film, which proved to be ovoid spores, filled with small granular matter (*conidia*). On the sixth day the cells changed somewhat in form, were more spherical. Again removing these to another supply of fresh wort, the results obtained were quite characteristic of an exhausted yeast ferment.

In following out the experimental method of research in the way I have endeavoured to point out, I am led to believe that the chemical action set up by the favus fungus in sweetwort is almost, if not quite, identical with that of the well-known ferment, brewers' yeast; in fact, a line can scarcely be drawn between them, the action of one is so nearly allied to that of the other, in breaking up complex bodies and transforming them into simpler ones. This is not all; for it appears that other simple plants, as penicillium glaucus, are just as capable of bringing about similar chemical changes by an action or process of fermentation peculiar to themselves, but which is probably controlled by the supply of oxygen.

* See Dr. Lowe's observations, published in the Edinburgh Botanical Society's Transactions for 1857.

A word with regard to the apparent differences in the fungi found on the skin. This depends almost wholly on the food or nourishment supplied; whether the pabulum contains more or less of a saccharine, albuminous, or nitrogenous material, &c. Diversity of form in the cells, as well as quality and quantity of their material contents, is certainly due to, and in a manner regulated and controlled by, the beautiful law of *diffusion*, which admits, separates, sifts, and refines the coarser from the finer, the lighter from the denser particles of matter, by the agency of the porous cell wall.

PORRIGO SCUTULATA. Syn. *Tinea tonsurans. Trichoses furfuracea. Herpes tonsurant.* (Trichophyton tonsurans, fig. 10.)

Porrigo scutulata (ringworm) in no way partakes of the nature of favus. Although a disease common enough in this country, it is apparently of rare occurrence in France; where for years its history was singularly confused or misunderstood by medical writers. It has been described as tuberculous, vesicular, or pustular, and as a contagious parasitic affection of the scalp. The peculiar tonsure-looking discs; the furfuraceous secretion; the dry, uneven state of the skin; the scattered patches; the broken, ragged hairs, often surrounded by filaments of a fungus and granular particles, that form a kind of sheathing to the cylinders, and cause them to become less transparent, and break off, when the skin is left bald. The interlacing of the mycelia about the hairs and epithelium partakes of a circular or spiral form, and imparts a ring-like appearance to certain portions of the affected skin. Porrigo scutulata and tinea tonsurans are not unfrequently described as distinct forms of disease; both are said to be varieties of favus. Be

this as it may, and after all it is a question of no importance, I am convinced that ringworm as well as favus is due to a deranged state of health, and does not originate in the epidermis, nor in the hair, but in the organs of secretion. The vegetation is a secondary product, and therefore, if attention be paid to the general health, and constitutional treatment resorted to, the most inveterate case of ringworm can be cured. Good air, good food, and tonics always starve the parasite; and the soil in which it grew and flourished no longer nourishes it; the eruption gradually disappears; and the hair resumes its healthy growth. This certainly seems evidence that the disease is not produced by the parasitic fungus. I have made many examinations of ringworm, and the following is a summarized statement of its microscopical character:—

Case 1.—Ringworm taken at school. In small circular patches about the scalp; in some parts minute vesicles, the discharge from which converted the scales into thin crusts; the hair very scanty and friable, mostly broken off short, and standing out abruptly. A fine fungoid growth visible over the surface of the hair, mycelia and filaments branching off in various directions; epithelial scales shrivelled and abundant.

Case 2.—Ringworm in a sister of the former patient; the disease presented similar appearances, but the fungoid growth was not so decidedly developed.

Case 3.—Filaments and fungus spores; the hairs presented peculiar swollen or bulbous protuberances.

Case 4.—Fungus growing as it were out of the hair at its insertion in the skin; epithelial scales numerous.

Case 5.—A remarkable twisted condition of the hair, which was covered with fungus spores, but no filamentous growth.

Case 6.—Hair a good deal matted together by the discharge, and mycelia threads; a chain of spores pro-

jecting from the hair, as shown in a case of plica polonica by Küchenmeister.

Case 7.—Ringworm after the dropsy or scarlatina. The hair and epithelium scales matted together in considerable patches, in which were mycelia filaments and spores; the latter in chains a few lines in length.

Case 8.—General health much deranged. Filaments and spores visible about some of the hairs, but not very numerous.

Case 9.—Hair twisted, and split up into a fine tow-like appearance; epithelium scales freely distributed about the patches; spores of fungus, with fine molecular matter. As these were mixed with a large quantity of fat globules, the examination was somewhat inconclusive.

The fungus, microsporon, or trichophyton tonsurans, Greely and Gruby tell us, should be found in all cases, spreading about the roots of the hair, and taking a direction up the shaft; while the microsporan audouini, the supposed parasite of porrigo decalvans, produces a kind of tubular growth around the external part of each hair, and not in the follicles or beneath the skin. I have been unable to verify this statement, nor do I think it can be maintained; it is, however, of no diagnostic value in determining the treatment of the disease, the pathology of which is a deranged condition of the healthy functions of the skin. Above all things it is necessary to direct particular attention to the general health, and employ a tonic regimen, when the irritation and eruption speedily disappear.

PORRIGO DECALVANS. Syn. *Tinea decalvans. Alopecia.* (Microsporon audouini, figs. 8 and 9.)

My next illustration is drawn from Willan's fifth order of skin diseases, *Pustulæ*, so called because most

of them make their appearance in an elevation of the cuticle as a pustule, with an inflamed base, unaccompanied by fever, not communicable, and occurring chiefly upon the arms, legs, and head. By the expression "not accompanied by fever," Willan intended to imply that these diseases were quite distinct from the eruptive fevers, and the pustules of small-pox and other pocks. Nevertheless, a form of porrigo is believed to be contagious, and Willan was evidently of that opinion.

Ringworm, it is known, rapidly spreads among a family of young children, or in a school, while porrigo decalvans is considered to be of a non-contagious nature, although persons living under the same roof, and the same unfavourable conditions to health, are often seen to be affected at the same time. This disease can scarcely be mistaken for the baldness of age, or premature decay of the hair, for it always appears in isolated patches, and the denuded spots are left clean and polished, and of a marble whiteness. Although it may begin in the head, it commits strange vagaries, inasmuch as it moves about, leaving a spot in the whiskers bare, and passing on to the eyebrows, where another spot is denuded. The progress of alopecia is frequently rapid, and occurs in children and adults; if among the former, it often attacks the greater portion of a school, and this most undoubtedly arises from aggregation, sleeping in the same noxious air, and partaking of a diet that is, probably, not sufficiently nourishing. Alopecia, like ringworm, is an evidence of lowered vitality, when the cutaneous surface very readily proves to be a congenial soil for the growth of a parasitic vegetation. The fungus known as *microsporon audouini* is said to produce the disease; the light-grey crusts that cover places deprived of hair are often covered with fungoid threads or spores.

I give as shortly as possible the microscopical results obtained from the examination of twelve patients suffering from alopecia.

Case 1.—Alopecia general; the hair near bulb found covered with threads, mycelia, which appeared to penetrate below the surface.

Case 2.—Alopecia circumscripta. Baldness of portions of the scalp and face; hair examined from the whisker, and small crusts extending to cheek. In the masses of epithelial scales and hairs, fungoid filaments were found, and portions of shaft of hairs covered with spores and threads.

Case 3.—Circumscribed alopecia of the scalp. Hair with mycelia standing out from shaft; the hair itself contained more colouring matter than usual, of a dark brown colour.

Case 4.—Alopecia of the whole of scalp and greater part of body. The few hairs extracted were distorted, broken, and devoid of pigment; nevertheless, a few tufts of spores were grouped in portions of the hair.

Case 5.—Alopecia confined to the head and face. The few straggling hairs were entirely deprived of colouring matter, but depolarizing light; sporules and broken mycelia were found.

Case 6.—Alopecia circumscripta. Bald patches, more particularly confined to occiput, and extending to the ears; hairs very stumpy and devoid of colouring matter; surface striations obliterated by the spores and filamentous material.

Case 7.—Alopecia circumscripta. Bald patches numerous over scalp; hair covered with fungus growth, standing out erect from the shaft; nearly all colouring matter absent. A second examination of this case made three months after treatment by tonics, chiefly arsenic; the hair it was noticed had regained its healthy character, and no spores or mycelia could be discovered.

Case 8.—Alopecia circumscripta. Three distinct bald patches about scalp; the rest of hair profuse; no vegetable growth visible.

Case 9.—Alopecia syphilitica. Hair presenting a peculiar appearance from having a second or outside casing of epithelium covering a portion of the shaft: no spores or threads of fungus were found.

Case 10.—Alopecia circumscripta. Several bald spots and grey patches throughout the scalp; hair distorted and deprived of colouring matter; a quantity of epithelium scales surrounded the shaft, but no vegetable growth.

Case 11.—Alopecia circumscripta. Baldness confined to the head; hair broken and dirty, giving it a dark-brown colour; many of the broken hairs were covered by spores and mycelium.

Case 12.—Alopecia complete. Nearly every part of the body denuded of hair, a few eyelashes remaining; no fungoid growth, although the patient seemed to be rather afraid of water. In the course of a few months a considerable improvement took place; a new growth of hair appeared under the arsenical treatment and the application of a stimulating ointment.

Summary.—In eight of these cases it will be noticed a vegetable fungus was found; while in the other four, one of which was associated with syphilis, no fungoid growth was detected.

Although alopecia can be readily cured in young persons—indeed is susceptible of a spontaneous cure—it is often obstinately persistent in the adult. Arsenic is certainly one of the most efficient remedies, and in most of my cases its use has been attended with excellent results.

Sycosis menti. Syn. *Mentagra. Tinea sycosis.*
(Microsporan mentagrophytes, fig. 12.)

I make no attempt to observe the order or arrangement usually adopted by dermatologists; this is indeed

quite unnecessary, as I am exclusively dealing with parasitic diseases. I therefore proceed to notice sycosis menti, and chiefly so from the fact that this affection of the skin derives importance from the observations of M. Gruby, who first described a cryptogam growing among the crusts in the beard, and which he not only looked upon as a new species, but as a contagious mentagra.

Willan describes sycosis as "an eruption of inflamed but not very hard tubercles, occurring on the bearded portion of the face and on the scalp in adults, usually clustering together in irregular patches." He thinks, with Celsus, that it may be divided into two kinds—*Sycosis menti*, which attacks the bearded portions of the face, and *Sycosis capillities*, chiefly confined to the scalp. The disease commences slowly; at first, small red pimples are seen about the chin and in the beard; these gradually increase, and, running together, break, and a yellowish watery discharge exuding, mats the hairs; in a short time the pustules increase, coalesce and form crusts that much resemble the inside of a fig; and from this circumstance it derives its name. The disease is inclined to become chronic, and attack other portions of the body, especially those parts freely supplied with sebaceous glands. It is known also to attack the eyelids and cheeks of females as well as males. Patients not unfrequently apply at the Eye Hospital for advice; the eyes and skin being simultaneously affected. In such cases, iron and cod-liver oil are invaluable remedies, especially when combined with change of air and a good wholesome diet.

Sycosis is admitted to be a constitutional affection; even a neglected dyspepsia will greatly aggravate or prolong the disease, and therefore local applications are rarely of any use; and this is the best evidence that the parasitic fungus is not the cause of the disease. The glandular structure of the skin is an important element

in modifying and changing the aspect of the disease. M. Gruby believes that it is solely due to the ravages of *M. Mentagrophytes;* this fungus forms a sheath round the roots of the hair, and its spores are produced beneath the epidermis, and that both filaments and spores are decidedly larger than those of the microsporon furfur. This, in my opinion, is a very doubtful statement. I made microscopical examinations of specimens taken from six well-marked cases of sycosis, in all of which the hairs were broken and twisted by the mycelia and spores, mixed up in the dark, yellowish scabs, and matted together. In one or two instances the fungus and epithelial scales formed a kind of beaded surface over the shaft of the hair; but in no instance did either mycelia or spores penetrate the cuticle. The discharge from a recent scab was seen to consist of fatty matter, pus-like cells, a few blood corpuscles, and altered epithelial scales. Gruby attaches too much importance to the size of the spores, as indicating a species. I regard size as a thing of no importance whatever in a vegetable growth; this, as I have shown, entirely depends upon age, soil, &c.

PITYRIASIS VERSICOLOR. Syn. *Chloasma. Pityriasis lutea.* (Microsporon furfur. Fig. 11.)

Pityriasis is classed by Willan among squamous affections. *Squama,* a scale, "a lamina of morbid cuticle, hard, thickened, whitish and opaque," is the description given of the disease by this physician. The laminæ are very thin compared with the eruption, and the incrustations formed after the pustules burst and run together. Frequently a fine mealy or scaly desquamation takes place, and the epithelium scales freely drop off when the skin is rubbed to relieve the irritation which accompanies the affection. Pityriasis is essentially a disease arising out of a deranged or low

state of health, although some dermatologists look upon it as "a superficial chronic inflammation of the skin." Mr. Hunt always described two varieties of the disease, one contagious and local, the other non-contagious and constitutional. The former is the least common, and may be distinguished from the latter by "the borders of the patches being more distinctly shaded off, and more irregularly diffused."

Microscopical examinations of seventeen specimens of this disease, taken from as many patients, gave me the following results:—in all, spores and mycelium of a fungus were found. Erichstadt, in 1846, first detected evidences of a fungoid growth in connection with pityriasis versicolor; and he described at the same time spores piled up in groups or heaps, and mycelia penetrating the skin; and, looking upon this as the cause of the disease, it was named *microsporon furfur*. Robin has not been able to satisfy himself of the identity of this species, or of the grouping of the spores as a particular characteristic. I, however, saw in several cases this grouping of the spores; while, in others, the matting together of the hairs by the discharge tended to mix spores and mycelia up in an incongruous mass. In Case 1, Mr. N. in a bad state of health and suffering from phthisis, the patches about the trunk were of a yellow-umber colour, the epithelium scales were large and mixed up in a yellowish discharge, and the hairs were partly covered with clusters of spores. A broken-down state of health was observed in a very large number of the cases; and when the scales fell off, distinct red patches of the skin marked the spots for a considerable time. The affection is a good deal aggravated in those persons who ignore the daily use of the bath, and, as a rule, are afraid of soap and water. Tonics, regular living, good diet, and change of air, will effectually cure the disease.

PSORIASIS. Dry-tetter. *Lepra.* Scaly Disease. Fig. 13.

Psoriasis and Lepra are two names for one and the same disease; the former seems to be employed by authors when the scaly patches are irregularly diffused, and the latter when the patches are more isolated and circumscribed, and present elevated edges, denoting a more active, though a less extensive state of disease. In almost every case, the primary affection is thought to be a chronic inflammation of the dermis, producing a vitiated state of the secretions, and an arrest of function. The eruptive patches in the first instance assume the form of an inflamed elevated ring.

The disease is met with in young children, and in persons of a fair complexion; it frequently shows itself about the elbows and knees. Psoriasis is called by some dermatologists *Lepra alphoides*, from the whiteness of the scales. The extent and severity of this squamous affection in certain subjects, has suggested a further division into *psoriasis guttata*, applied to patches which appear as pearly drops on the surface of elevated spots; and *psoriasis inveterata*, when the scales assume the form of a hard crust over a great part of the body, and very soon fall off in quantities. The disease then causes a smarting, troublesome state of the surface generally. In all, twenty cases of the various forms of psoriasis and lepra were examined; and in twelve of them spores and threads were found, mixed with epithelium and granular matters; but in no respect did the fungoid elements appear to differ from those discovered and described as belonging to other *Dermatophyta*.

There is yet another well-known variety, *Psoriasis syphilitica*, first described by Willan as a scaly eruption having a syphilitic origin and presenting a copper-coloured appearance. In *psoriasis ophthalmica* a patch or

circle extends to the borders of the eyelids, which become swollen, tender, and painful. It frequently encroaches over portions of the conjunctiva, and the pustules produce a large amount of irritation, and assume a somewhat obstinate character. This affection is sometimes associated with pityriasis, but is distinguishable from it by the small and distinct nature of the pustules. That psoriasis is not of local or parasitic origin is proved by the failure of topical applications in its treatment; while, in a short space of time, a course of tonic remedies, even without the use of the bath, always so essential to health and comfort, the disease will be perfectly cured.

Lepra Vulgaris. *Lepra alphoides.* Fig. 14.

Lepra closely resembles psoriasis; one is simply a milder form of scaly eruption, and appears in persons of all ages. Mr. Hunt says, "when the patches are round and distinct, and depressed in the centre, I call it lepra; when not so distinctly circumscribed, then psoriasis." These affections are idiopathic forms of disease, very commonly attacking persons advanced in life—age indeed is often a most important factor in skin diseases. In most of the patients from which my specimens for microscopical examination were taken, the scaly eruptions appeared first as small circumscribed spots, chiefly confined to the arms and legs; the central portions of each were occupied by whitish scales, while their margins and the surrounding skin were of a pale-pink colour and slightly raised. In five cases, I found spores and mycelia almost identical with those of psoriasis; while in two, epithelium scales and minute fatty matters only were seen. It is very surprising to see how rapidly patients suffering from lepra improve in health under small doses of arsenic, and simultaneously all fungoid growths disappear.

Eczema. Syn. Vesicular Eruption. Running. Scall. (Fig. 15.)

Eczema is an eruption attended with severe irritation and itching of the skin. It is described by Willan and Bateman as "an eruption of small vesicles on various parts of the skin, usually crowded together, with little or no inflammation around their base, unattended with fever, and not contagious." This disease is common enough among children during the first and second dentition, and is often associated with eye disease—is, indeed, one of the most troublesome cutaneous affections of childhood. It affects many parts of the body, as well as the head, face, and eyes, and the vesicles pour out an irritating fluid which excoriates the surrounding skin; this, however, soon dries up and scabs over, the colour of which is first a greenish yellow, and afterwards brown; chaps and fissures succeed, and the epidermis, and frequently the deeper structures, become involved in the inflammatory process. The hair is matted together by the discharge, and in four out of six cases examined I observed the spores or mycelia of a fungus. In one, the spores were in masses or minute heaps; and in another, an epithelial cast, from which the hair had escaped, was surrounded by a filamentous growth that had probably encircled the hair, represented in fig. 15. In a case of eczema leproides, the spores were circular and unusually minute, and the epithelial scales were hypertrophied.

Some authors divide the affection into an acute and chronic stage, and include under the term eczema various forms of lichen and impetigo. The crusts or scabs of eczema are palpably of a dark-brown colour, while impetigenous scabs are of a dirty yellow colour. The disease, when confined to a certain portion of the scalp, occasionally assumes a dry, scaly appearance, and may then possibly be mistaken for psoriasis. It has been attempted to

prove that a gouty diathesis is a proximate cause of eczema. This, however, is not in accord with the experience of dermatologists, who regard the disease as one dependent upon functional or nerve derangement; and this view explains why it selects certain parts of the body in preference to others, and why injury to a nerve trunk is often followed by herpetic and eczematous eruptions. The influence of the nerves in cutaneous affections is now an admitted fact; consequently nervine tonics—iron, cod-liver oil, &c. with good diet and open air exercise—are most essential and useful in their treatment.

Mr. Erasmus Wilson writes:—"All cases of eczema are associated with lowered vitality; in infancy, invariably with defective nutrition and deficient feeding; in middle life, with mal-assimilation; and in after life, with mal-assimilation, associated with irritability, waste, and decay; and consequently in its treatment, during the growing periods especially, every cause of exhaustion must be met and treated." He thoroughly believes in the value of iron and arsenic, and drugs that act constitutionally, or upon the nervous system. As an external application for the purpose of allaying the irritation of the skin and the troublesome itching, there is nothing better than benzoated oxide of zinc.

Willan highly extolled coal-tar as an external application in eczema; and Bateman wrote of it, in lepra, "the continued application of tar-ointment has effectually cleaned the skin of the patches and restored its texture, even when internal remedies seem to have failed: but the advantage obtained is not always permanent." The *Ungt. picis liquidæ* of the Pharmacopœia is doubtless an excellent stimulant, and especially adapted to old and ill-conditioned ulcers. I have seen it, when combined with equal parts of cod-liver oil, effect much good in conjunction with constitutional treatment in eczema and

other skin affections. Its unpleasant smell and damage to the clothing is much against its employment; but this may be obviated by applying it at bed-time, and by well dusting the surface with violet powder; or, as Hebra directs, by taking a warm bath an hour or two after its application. Oil of cade is also much employed in the treatment of eczema of the scalp. This oil, when diluted with an equal quantity of oil of almonds, answers well in cases of lichen and psoriasis, as well as in so-called parasitic diseases. Professor Erasmus Wilson employs a lotion composed of equal parts of the oil of cade and spirits of wine, added to six times the quantity of water, as an anti-puriginous lotion. The oil of cade, mixed in equal proportions with the Unguentum Zinci, is very useful as an external application in eczema, after the crusts have been removed by poultices. The ointment may be kept constantly applied to allay the irritation. If, however, there is much redness of the skin, with pain and a burning sensation, the disease is in active condition, and will certainly not bear any of the tar preparations: during this stage, soothing treatment, warm baths, mild alteratives, and constitutional remedies must be employed. If tar preparations increase rather than allay irritation of the surface, they must not be persevered in. If, on the contrary, the scaling process is actively going on, the stimulating effects of these preparations will be found useful; but to attempt the cure of idiopathic eczema by the application of either lotions or ointments, will be found a hopeless task.

Impetigo. *Running Tetter.*

This disease, which Willan places among *Pustulæ*, is characterised by small pustules with an inflamed base, that burst and run together, and produce scabs. It is

not accompanied by much constitutional disturbance; nor is it communicable, although it may attack all the children of the family about the same time. Impetigo of the head often proves as troublesome a disease as eczema; it is as important when it makes its appearance on the scalp, and as difficult to cure. In young children, the eruption is almost confined to the pustular form, which spreads over the head, and produces incrustations. In this form it is usually described as *crusta lactea*—milk crust. At other times, and when the pustules are very small and of a mixed character, vesicular, it is termed impetigo eczematosa. If the hair happens to be long, it becomes mixed in the honey-like brownish scabs, and falls off. In such crusts, as well as about the hair, I have repeatedly found fungous spores, epithelium scales, and pus-like corpuscles. The hair bulbs are not destroyed or in any way affected; the hair therefore is soon restored. In some cases the incrustations are scattered over the head in small patches; this form of disease Willan calls porrigo granulata. Impetigo attacks the feeble child during the teething process; it is probably symptomatic of the physiological process of dentition. By far the larger number of cases of this disease are associated with imperfect nutrition and debility. Poverty, privation, and dirt are among the most frequent predisposing causes; and tonics—the iodide of iron, arsenic, and cod-liver oil —with an occasional use of chalybeate aperients, prove to be the most efficient remedies.

Impetiginous diseases usually run a course, and the fungoid spores and threads found in connection with them must be looked upon as evidences of a neglected state of the skin, and not as a part of the cutaneous affections. Among the poor especially, the difficulty made about washing, and the general neglect of baths, as well as the almost universal application of bread poultices, mouldy frequently when used for the purpose, and por-

tions of which are allowed to adhere to the scabs, go far to deceive the experienced observer as to the parasitic nature of the disease under investigation. In most cases, soothing applications—warm water freely applied in this as well as in other cutaneous affections of children—and the use of tonics, with chalybeate medicines, which correct the defect in the blood-making process, will cure the disease.

Herpes. *Dry Tetter.*

Herpes, or dry tetter, is placed by some authors among vesicular diseases; it was at one time a generic name for a number of cutaneous diseases. I have seen a small herpetic ring on the trunk described as a patch of lepra. A good deal of confusion existed with regard to this disease, for Alibert alludes to a contagious form of herpes. It is of great importance to determine whether the disease has a specific syphilitic origin. Squamous affections not unfrequently belong to this category, and are then most difficult to cure—seldom indeed cured without the aid of special remedies. The reddish-brown or copper-coloured appearance of the eruption, if associated with syphilis, is very striking. The appearances, taken in connection with the history of the case, generally serve as a guide to a correct diagnosis and treatment. The affection known as herpes zoster is ushered in by a slight feverishness, which lasts probably for a day or two, and is succeeded by lassitude and depression. The regular well-defined eruption often extends round the greater part of the body, and is accompanied by severe neuralgic pains, which are lasting. In a case some months under treatment before I saw it, the pain was excessive, and the patient found relief only in the constant inhalation of chloroform. Its use

was persisted in, contrary to advice, and until he was almost reduced to death's door, when, after the failure of all other remedies, a cure was effected by the continuous use of the galvanic current.

Herpes circinatus, Mr. Hunt says, "is occasionally mistaken for *Herpes tonsurans*, or ringworm, which it resembles only in the annulated form of its vesicles or papules." Dry-tetter occasionally assumes an epidemic character; and I have seen evidences of a fungoid growth, spores, and mycelia, in two or three cases submitted to me for examination.

Ichthyosis.

Ichthyosis (fish-skin) is included by Willan in squamæ. It is occasionally seen as a congenital or transmitted form of disease; the skin is so much thickened that it assumes a horny texture, with a tendency to fall off in large scaly patches; these are, in appearance, quite distinct from the scales of either psoriasis or lepra. In the specimens which have fallen under my notice, the epidermis appeared to be hypertrophied; the scales were completely condensed and blended together, and it was almost impossible, without soaking for some time in a solution of potash, to separate and render them thin enough for examination under high-powers of the microscope. This difficulty appeared to be increased in one or two instances by fungus threads binding the scales more intimately together, weaving them, as it were, into a consolidated mass.

Vitiligo (veal-skin) is a disease occurring in patches over the surface of the body; the scales fall off and leave a white state of the skin, not unlike veal in appearance. The scales are composed of epithelium, firmly held together by a thin watery exudation; a brown or

blackish granular matter is sometimes largely mixed up in the masses; but in no instance were spores or fungoid elements of any kind discovered.

LICHEN. (*Summer-rash*, fig. 16.)

Lichen belongs to Willan's order *Papulæ;* "papulous eruptions characterised by numerous small pimples, terminating in scurf, and containing no serous or purulent matter; the disease is connected with internal disorders." Bateman says "there is scarcely any limit to the varieties of these papular affections." *Lichen simplex,* occurring about the arms and neck, and over portions of the scalp, is most frequently met with during spring and summer, when it suddenly makes its appearance, and almost as rapidly disappears. It is common enough in tropical climates. Europeans, when affected with lichen during a residence in India, call it the prickly-heat.

The disease is sometimes confounded with eczema or psoriasis; but on examination it is seen that a number of red, dry pimples cover the edges of the patches, and, as a rule, it is found that these pimples are papular in lichen, and vesicular in eczema. *Lichen agrius* is a form of the disease that attacks the arms of grocers and bakers; it is also known as "baker's itch," for it is thought that the irritating particles of flour or other substances produce the disease. When lichen assumes a chronic form, I have found fungus spores and filaments of a reddish-brown colour invading the shafts of the hairs, similar indeed to the fungus found in *Mentagra.* In several cases the cutaneous surface was inflamed and swollen, and the epithelium blended together in a slight pale-coloured fluid discharge.

Lupus. (*The Wolf.*)

Lupus is placed by Willan among *Tubercula*, and he regarded it as a slow form of tubercular affection that gradually destroys the skin and surrounding structures, and penetrates to a considerable depth. It is not unfrequently divided into many varieties. Biett, who, it appears, saw a good deal of this affection, described it under three heads—that is, according to the seat it appeared to him to occupy. 1st, as "superficial lupus;" 2nd, as "deep-seated lupus;" and 3rd, as "lupus with hypertrophy." Rayer's description of the disease, however, is both practical and happy. "Lupus," he says, "is a chronic cutaneous inflammation, which usually appears in the shape of external tubercules of different sizes, singly or in clusters, of a livid colour, and indolent character, followed either by ichorous and phagedenic ulcers, which become covered with brownish and usually very adherent scabs—lupus *exedens;* or by extensive changes in the structure of the skin, but without preliminary or consecutive ulceration—lupus *non exedens.*"

Lupus exedens is, as its name implies, an ulcerating disease of the phagedenic kind, showing no spontaneous tendency to healing, or to the restoration of the affected parts. It most frequently ulcerates deeply without spreading rapidly in a lateral direction; in other cases, it spreads superficially, just destroying the cutis, leaving the subcutaneous tissue untouched, but extending its ravages laterally in all directions. "Whenever a young person complains of a sore spot within the ala of the nose, or on the septum, or exhibits an adherent scab of ever so small dimensions, situated on the top or side of the nose, or on the lip, surrounded by a base of a livid colour, a close examination should be at once instituted and carefully treated."

It is by no means uncommon to see patients suffering from this terrible disease at the Eye Hospital. The lower eyelid is very frequently the seat of the affection, and its destruction is almost certain. The eye is at times attacked by chronic inflammation; the conjunctiva, especially that part covering the palpebral surface, is very much thickened; the cornea loses its vitality and becomes opaque; and the upper eyelid droops from paralysis of its motor structures. In one or two instances, and when seen at an early stage, I have attempted to arrest the further progress of the disease by removing the affected surface, but without success; the phagedena has continued its destructive course. When lupus attacks the face, the ulcerating surface is covered by dirty-looking scabs, which desquamate and reform, until by deeper excavations of the subcutaneous tissues the alæ of the nose is exposed, and even portions of the bone. The whole of the face, and a part of the neck, in a female patient of about forty years of age now under treatment, is completely denuded of skin, and the lower eyelids are eaten away.

I have made microscopical examinations of the products of eight cases of *lupus exedens* (lupus, with phagedenic ulceration), and three of *lupus non-exedens;* in two only I discovered evidences of fungoid spores, mixed with epithelial scales, fat and pus-corpuscles, and dark-looking granular bodies. The pus-like discharge poured out is essentially of a scrofulous character; in some cases it is a serous-looking fluid, with white cells, irregular in form (probably white blood-cells), and containing nuclei, and largely mixed with granular matters; a relatively large proportion of fat is found in every specimen, and it appears that the disease leads to degeneration—probably disintegration—of the fat and sebaceous follicles; the glandular structures are, therefore, constantly throwing off their contents. The surrounding tissues are deeply

involved in the destructive process, which is brought about by a disease of the nerves, and probably an inflammation of the cutaneous structures, from "derangement of those forces which regulate the nutritive processes." It is not uncommon to find lupus attributed to hereditary or contracted syphilis. I have not been able to trace it to a specific origin, and therefore find it aggravated by a resort to mercurials. The prognosis in all cases is unfavourable, although, in my friend Mr. Hunt's practice, I have seen cases in which the disease has been arrested by building up the general health, and by employing cod-liver oil internally. In some cases arsenic is a specific —indeed the disease yields to medicine, without any topical application whatever; whereas a single case has never been cured by the employment of escharotics. Arsenic in such cases is no doubt a valuable remedy; but whether its action is purely catalytic, or whether it consists in disturbing and overcoming abnormal changes in the tissues, is difficult to determine.

Lupus is a perfectly different form of disease from that prevalent in tropical countries, and formerly well known in England and throughout many parts of Europe as leprosy. This affection is only now seen when brought to this country by residents or natives of India; and Dr. Carter believes its extinction in India depends upon rigorous segregation of those suffering from it. "Leprosy," he says, "is one depending upon mal-nutrition as well as upon hereditary transmission. The cutaneous nerves are chiefly and primarily affected in that part of their course between the outer skin and the deep-seated structures; and all the changes observed in the varying course of the disease may be traced directly or remotely to the characteristic nerve-lesion, which brings about a deposit in the skin as well as in the nerve-trunks, of a firm, translucent, colourless, or pale-reddish material. As regards the conjunctiva, and the mucous membrane

of the mouth and throat, the blood-vessels and accessory organs are so involved that the tactile corpuscles disappear before other less sentient elements, and the nerve tubules are separated, compressed, emptied of their contents, and eventually broken up as the disease progresses."

TINEA TARSI. Syn. *Ophthalmia tarsi.* CILIARY BLEPHORITIS. *Blear-eye.* Fig. 17.

Tinea tarsi is an eruptive disease closely allied and often associated with either psoriasis or eczema. It is regarded also as a porriginous or herpatic affection, one frequently attacking children, when it appears to be the physiological indication of a change brought about during the building up, or growth, of the human frame. It is also an indication of arrested functional activity, produced by some gastro-intestinal irritation. The disease is often confined to the eyelids; the hyper-secretion of the meibomian follicles becomes a morbid product, and destroys the cilia; the eyelashes drop out; or a very abundant secretion takes place during sleep that glues the eyelids together, and in the effort made to separate them the cilia are drawn out. The disease is in truth a glandular affection, one much aggravated when follicles and glands are inflamed. The tear outlet is obstructed by the conjunctivitis, and this leads to disease of the lachrymal gland; or, if the discharge is not carried away fast enough, the duct is liable to obstruction, the tears also run over, and the cheeks are excoriated. At a later period, the edges of the eyelids are covered over by dark-looking pustules and scabs, in which, among the children of the poor, pediculi are sometimes found.

In the chronic form of the disease a thickening and

turning down of the eyelids completes the miserable picture: the patient is then said to be blear-eyed.

Tinea tarsi shows itself in an inordinate proportion of the cases in the out-patient department of the Royal Wesminster Ophthalmic Hospital. A vast number of poor children from the dirty over-crowded dwellings of St. Giles's are always under treatment. Another class of sufferers are those who habitually indulge in strong drinks and eat unwholesome food. It is also a sequence of eruptive fevers, measles, scarlatina, &c. and difficult to cure. Tonics, cod-liver oil, good food, and cleanliness, are the remedies chiefly to be relied upon.

On submitting to microscopical examination several specimens taken from scabs and the pustular discharges about the eyes of seven patients, in two of which eczema of the face also existed, I found in four cases spores and filaments, epithelium scales and pus-like granules. In two, small bodies were discovered exactly like the spores of puccinia favi of Ardsten (shown in fig. 1). These spores, it should be noticed, are also frequently floating about in the air of towns and in the country. The bean crops are often infested by the same fungus, when the spores can be collected in any quantities. Tinea tarsi is occasionally associated with a pustular conjunctivitis.

Pustular Conjunctivitis.

Pustular Conjunctivitis. The conjunctiva or white-skin covering of the eye is a delicate transition structure, ranging between the mucous membrane of the true skin and the epidermis, and it very frequently shares in affections of the cutaneous surface. Children crowded together in ill-ventilated bed-rooms, in school hospitals,

refuges for the destitute, &c. suffer in a remarkable degree from pustular disease of the eyes. From the contagious nature of the disease, it is believed to be propagated by *germs*.*

The conjunctiva first assumes a red or livid look; the eyes water incessantly; minute vesicles form on the skin lining the lids; sago-like bodies are seen if the lids are turned down; and the eye is painful and irritable when exposed to the light. A very copious discharge of a whitish matter soon sets in, and minute pustules sometimes form near the margin of the cornea; the disease, if neglected, quickly proves destructive to the transparent covering of the eye. The disease can nearly always be traced to bad air, defective means of ventilation, and over-crowding; the want of a proper amount of nourishing diet always aggravates it. It is, therefore, more common among the children of the poor, and is often endemic in pauper schools, "school hospitals,"

* Dr. Beale believes that when *germinal matter* has its powers of growth perverted or degraded, it may obtain the power of indefinite multiplication, like the pus of an abscess, or the secretion from purulent ophthalmia. Such pus—that is, such degraded germinal matter—has the power of independent growth under various conditions, and is capable of maintaining its vitality for long periods, if not completely deprived of moisture. When introduced into another animal body, offering favourable conditions, it increases and multiplies. It would appear, therefore, that the growth of ill-conditioned germinal matter may be accompanied by the development of poison in the organism that supports it; just as the growth of mould changes the quality of bread, or cheese, or other substance, on and in which it is found. Dr. Beale, however, does not assume the existence of spores or other bodies, whose presence he has not yet discovered, but appeals rather to the germinal matter the existence and growth of which he says he has demonstrated; and although he does not look for the extinction of all contagious diseases, yet he does expect that much good will be derived from keeping the body in an unsusceptible state—by living in good and pure air, by dryness and plenty of sunlight, and especially by general cleanliness, as preventives of these forms of disease. —*Medical Times and Gazette*, 1866.

and places where large numbers of children are aggregated together.

A government pauper school, built at an enormous cost to the county, may always be looked upon as a focus of infection for eye and skin diseases. I have constantly under treatment at the Ophthalmic Hospital boys from the Refuge and Ragged Schools. It appears that on the first introduction of boys taken from the streets, ophthalmia, as it is called, breaks out, and affects one new comer after another. The greater part of these boys are brought from wretched homes, half starved, and in rags, and for the first time made clean and fed on wholesome food; notwithstanding all this, the children become affected with a destructive form of ophthalmia, and for a time fall into bad health. The explanation seems to be that children are destined for an out-door life with plenty of exercise; the moment they are taken from the gutter and cooped up, aggregated in school hospitals and imposing structures, and limited to a given space, made to breathe the same air, or re-breathe that already deprived of its oxygen and loaded with carbonic acid, and the exhalations of hundreds of other children, then the blood, insufficiently oxygenated, loses its vitality, and the nervous system becomes depressed, and ultimately they fall an easy prey to diseases of the skin and eye.

Years ago* I warned those who were bent upon building palatial pauper schools that failure would be sure to follow. Those at the head of the Poor Law system of the country, and in the face of an array of facts brought to their notice at the time when the danger to health and morals by herding children together under one roof was under discussion, refused to listen to the voice

* See numerous letters and articles on this question in Examiner and Observer newspapers, 1868 and 1869.

of reason and common sense. A trial asked for a Scotch *boarding-out system*, which had already been demonstrated to be healthier for children, as well as more economical for the country, was scouted. The school at Hanwell, said to be a success, was shown by the Medical Reports of 1869 to be suffering greatly from ophthalmia—indeed, just then the disease prevailed to an alarming extent; 70 per cent. of the children were affected, while not more than 22 per cent. in workhouses with less cubic space suffered—a proof positive that this affection is propagated and fostered in over-crowded school and sleeping rooms. No costly means of ventilation prevents disease spreading in buildings of which the boast is that 400 cubic feet and more is allowed to each child, play-grounds covered with Yorkshire flags, the equal of which is not to be found in any private school in the kingdom, and where the cost of maintaining children is above £20 a year per head, a sum that would keep half as many more if the Scotch boarding-out system were followed—a system moreover known to prevent "sore eyes and eruptions of the skin among children."

Miss Nightingale truly says—"Children are, as it is well known, the very touchstone—the live tests of sanitary conditions; and but too often the dying and dead tests of insanitary." This is as true of the insanitary, imposing architectural "school hospitals," as it is of the underground dwellings of the poor. Both are examples of the neglect of hygienic arrangements, a vitiated state of the atmosphere from accumulations of animal matters, and the deadly carbonic oxide. Grown-up people frequently suffer from similar causes. A remarkable confirmation of this fact is recorded by M. Huss, who says, among the Lapps of North Sweden ophthalmia is endemic, and it is due to the over-crowding in-door life adopted during the winter months,

when the greater part of the poor inhabitants are cooped up in a close, foul atmosphere, in huts, where there is no escape for the smoke even, except through a small hole in the roof. Most of these people, children and adults, therefore suffer from eye disease, which cannot be cured before the open months of the year set in, and they turn out into fresh air and light to pursue their usual occupations of fishing, &c. So prevalent is ophthalmia among the inhabitants, that scarcely an old Lapp will be seen without blear-eyes or granular lids.

The treatment of this disease may be almost surmised from what has already been stated about its cause; indeed the cure is at once simple and efficacious. Affected children must be separated as far as possible both by day and night; daily exercised in the open air, and put upon a diet of meat, eggs, milk, and vegetables, without stimulants. To allay the troublesome irritation, and remove all discharge, a weak, astringent solution must be applied to the eyes, and full doses of iron or ammonia and bark administered two or three times a day. Under no circumstances must children suffering from eye affections be permitted to use the same wash-hand basin or towel.

There is a peculiar variety of pustular disease of the conjunctiva, about which I must say a few words—it is usually associated with variola, or small-pox—*ophthalmia variola*. In this affection, one or more pustules are seen on the eyeball and on the eyelid, and, if neglected or overlooked, will often end in ulceration, prolapse of the iris, and destruction of sight. During the suppurative stage of small-pox, it is difficult to make out the mischief going on beneath closed and swollen lids. In one or two cases I have met with the spores of a fungus; these, I believe, must have been conveyed to the eye in the lotion or dressing. *Ophthalmia fungosa* and *Sarcosi*

bulbi have been described as fungoid diseases of the outer skin of the eye; but as they are in no way associated with a vegetable growth or fungus, this is clearly an error. It was, indeed, an egregious blunder of former days to describe "loose-looking textures" growing from the surface of the eye and other situations, as "a fungoid growth;" such growths bear no resemblance to a product of the vegetable kingdom, and it is very misleading to continue the use of a term which conveys neither the character nor nature of the growth. A similar objection may be taken to the retention of the term *herpes iris*, in describing a disease which may appear in the form of a concentric ring over a part of the body as well as the eye.

Diphtheritic Conjunctivitis.

Diphtheritic Conjunctivitis is another affection of the skin of the eye, in connection with which I have found the spores of oïdium albicans. Diphtheritic conjunctivitis, although commonly enough met with in Germany, where it is said to occur both as a sporadic and as an epidemic affection, is rarely seen in this country. Out of some three or four thousand patients who annually come under my notice at the Royal Westminster Ophthalmic Hospital, certainly the average must be less than one in a thousand suffering from this disease. Those who have had opportunities of observing its course will agree that it is most intractable to manage, and very destructive to the tissues of the eye—even more so than was the famous Egyptian ophthalmia of the Peninsula. By reason of its rarity and its rapidly fatal character, I trust a short account of one or two cases will not prove devoid of interest.

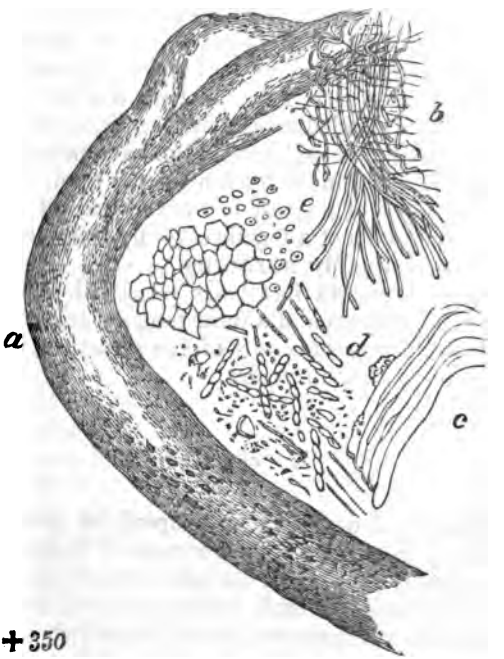
In the early part of 1870, I was requested by my

friend, Dr. Ridsdale, to see, in consultation with him, the child of Mr. M——, a fine boy about fourteen months old, who had been suffering for some days from a severe attack of catarrhal conjunctivitis. The parents were somewhat unusually alarmed about their child's condition, and this I found arose from the circumstance that their eldest boy, some three or four years before, had lost the sight of both eyes. The discharge from the boy's eyes was excessive, and the attack a smart one; but in about eight or ten days he made a fair recovery. During the autumn of the year, I was once more summoned to see the little fellow, suffering, it was supposed, from a return of the disease. His general health was not so good as on the former occasion; the mother attributed this to teething and want of sleep, and the symptoms of the affection seemed to be greatly aggravated. On the second day, a dense white membrane covered both corneæ, and quite obscured the pupils from view. I saw at once that we had a case of diphtheritic conjunctivitis to deal with. Every kind of local application and internal remedy was successively tried, but in vain. A dense membrane reformed day after day; and first one cornea and then the other sloughed away. At the end of about three months the disease began to wear itself out; and by careful nursing and good feeding the boy gradually regained his health, and was as happy and playful as a blind child could be.

In the spring of the year 1872, diphtheria appeared in the neighbourhood of Mr. M——'s residence as an epidemic visitant. Soon after, the eldest blind boy complained of sore throat; in a few days this proved to be tracheal diphtheria, and in less than a week he was dead. The youngest boy was next seized, and in an equally short space of time he also died. One or two of the girls of the family were similarly affected, but made good recoveries. More careful inquiries about the eldest

boy's first illness inclined me to think diphtheritic conjunctivitis was also the cause of his loss of sight. The predisposition evinced by the males of the family to take the infection of diphtheria was certainly very remarkable. None of the children, the mother assured me, ever suffered from an attack of croup; both parents enjoyed an average amount of good health. Several microscopical examinations of the diphtheritic exudation were made throughout the attack. Now, I find considerable differences of opinion prevailing on the general and special characters of the diphtheric membrane, and also on its histological morbid anatomy. Many competent observers, both in this country and on the continent, maintain that diphtheria and croup are separated by "clinical tradition" only; that "the false membrane found in one differs in no important particular from that of the other and allied diseases." This is quite an erroneous view, as I have shown. (The *Lancet*, March 15th, 1873.) On teasing out a small portion of the dense membrane to fit it for microscopical examination, under a low power (100 diameters), the normal tissues appear to be replaced by a dense network of fibrous tissue. A power of 350 diameters reveals an aggregation of granular matters, nucleated epithelium, fat-molecules, and minute crystals, closely packed and held together by interspersed bands of connective tissue; muco-purulent corpuscles entangling foreign bodies and spores of the oïdium albicans, as represented in the accompanying wood-cut. The membrane is, in short, a laminated fibroid mass of the superficial and deeper-seated structures. In a later stage, the glandular structures and denser coats of the eye are involved in an ulcerative destruction. That the mucous membrane is affected by the infiltration as well as the more superficial structures, is evident from the loss of sensibility in nerve fibre. Virchow is also of opinion that an exudation takes

place into the substance of the mucous membrane, and that this produces tension, and subsequently ulceration.



Microscopical appearance of a Diptheritic membrane.

Vertical section cut from the dried specimen, showing *a*, dense fibrous or connective tissue and condensed epithelium cells; *b*, teased out fibrous tissue; *c*, involuntary muscular fibres; *d*, oïdium albicans; *e*, separated and shrunken pavement epithelium cells.

Spilus. A Mole.

Spilus is a kind of nævus or mole, classed by Willan among *macula*, a spot. Two cases were subjected to a microscopical examination. *Case* 1.—Dark-brown moles about the clavicular and cervical regions, prominent, and increasing in size, were removed from a child four years old. Hairs protruded from the peculiar-looking dark masses chiefly composed of epithelium and minute granular bodies; but nothing like a fungus was seen. *Case* 2.—Numerous moles of a small size were removed from the shoulder and axilla of a female child five years old, dark-coloured, and rapidly increasing in size. Among the dark-coloured masses fine hairs projected, which were surrounded by threads of a dark fungoid growth, with a few spores. The greater part of the structure, however, consisted of epithelium scales.

Molluscum.

Molluscum, a dark-coloured superficial growth, that shows itself in parts where sebaceous follicles abound. It is frequently seen about the nose, eyelids, and certain parts of the face and neck, and is supposed by some to be of a contagious character, and is termed in consequence *molluscum contagiosun*. It is also believed that this is due to the growth of a parasitic fungus. I have examined several of these growths without discovering a trace of a spore; and therefore, if a fungus has at any time been observed, it must have been an accidental introduction, having no share in causing the disease.

So with regard to similar horny-looking growths of the eyelid, and in which some observers have detected the spores of a puccinia. It is quite certain that the

fungoid elements had nothing whatever to do with this superficial affection; the disease is simply an exaggerated epithelial outgrowth—a piling up of the outer layer of scales. In a case which came under my care at the Royal Westminster Ophthalmic Hospital—a report of which, accompanied by a drawing, will be found in the Pathological Society's Trans., 1871, p. 349—the erectile horny growth increased to a considerable size, upwards of an inch and a half in length. A careful microscopical examination showed its composition to be condensed epithelium cells, a thick muco-purulent secretion, and layers of connective tissue, without a particle of a fungoid or parasitic growth.

Mycetoma. *Madura or Fungus-foot Disease of India.*

It is alleged that the spores and threads of a fungus penetrate the superficial and deeper seated structures of the foot and hand, and cause the disease mycetoma, fungus-foot of India. Dr. H. V. Carter was the first to discover the disease, and he described three varieties of the fungoid growth. In the first, the fungus occurs in the form of large globular masses, black externally, brown within, and having a radiating appearance on making a section. In the second variety, the fungus is always in the form of small particles, lighter coloured, and composed of threads, and round or oval cells, mixed up with granular matter and oil globules; or the masses may be pink in colour, and made up of minute beaded fibres, which have the appearance of fishroe-like bodies. The third variety principally consists of light-brownish granules, in a crystaline fatty envelope, whose structure is a miniature condensed form of the black fungus first described.

I have had the opportunity of examining three specimens of the Madura or fungus-foot, one of which, and the last examined, was taken from a foot in an early stage of disease; and in this, after some difficulty, I found little nests of soot-like balls, of a very minute form, of fungus threads; in another specimen, I failed to convince myself that the disease was in any way due to the presence of the small amount of fungus mixed up in portions of the structure. My observations were recorded, with drawings of the microscopical appearances, in "The Monthly Microscopical Journal," vol. ii, p. 61, 1871; and also in "The Medical Times and Gazette," July, 1871, page 93. The conclusion I formed of the nature of the disease differed somewhat from that of Dr. Carter, inasmuch as I look upon it as a neuroses, a blood affection caused by disease of the nerves of the part, and brought about by mal-nutrition or hereditary transmission. The latter is something more than a surmise; it is borne out by the fact that the disease is pretty much confined to certain districts. That the cutaneous nerves are either primarily or secondarily affected is certain; the course the disease takes proves this. A contraction of the smaller arteries leads to an arrest of the proper supply of blood to the nerve tissue, and permits of an easy disintegration of the cutaneous structures by the spores and mycelial threads of a fungus.

A number of specimens of the foot have been seen and examined in this country, and Dr. Carter's description of the disease and its histological and pathological characteristics have been generally accepted. It appears, however, that occasionally specimens have failed to satisfy those into whose hands they have fallen of the fungoid character of the disease. Dr. Carter speaks of such a specimen as a variety with "numerous rounded bodies of a structureless or finely granular appearance, in which the fungoid particles are free from

crystaline fringe, and showing a cellular structure, the true nature of which is 'degenerate fungi.'" * A specimen of this variety appears to have perplexed Dr. Ballingall, as well as the late eminent microscopist, Professor Quekett, both of whom were in consequence unable to satisfy themselves of the fungoid nature of the disease.

At the end of the year 1869, a foot of the same kind came into my possession for examination; and I must admit I was a little surprised and somewhat disappointed, after a carefully conducted examination, to be obliged to say it presented no proof that this unusual form of disease was due to the growth and destructive ravages of a fungus.

The naked-eye appearances of the fungus-foot were as follows:—The foot was greatly enlarged and swollen, with numerous excrescences, fungoid-looking bodies, distributed over the upper part, none on the lower. At first sight these might have been thought to communicate with the internal structures; but on attempting to pass a probe through the centre of any one of them, it could not be made to penetrate more than a short distance; and I doubt very much whether there could have been any actual sinuses leading to the bones during any stage of the disease. The hardening nature of the methylated spirit in which the specimen was preserved may, however, have had something to do with their obliteration. On making a vertical section of the foot, much confusion of parts existed, so that the muscular, fibrous, and connective tissue, as well as the vessels, seemed to be blended in a semi-gelatinous mass. On removing portions of the bony mass, most of the compact tissue of which had evidently been absorbed, the cancellated interspaces were found occupied by numerous

* Transactions, Bombay Med. and Surg. Society 1860-62, and *Medico-Chirurgical Review*, vol. i, 1863, etc.

whitish compact bodies, somewhat resembling millet seeds. These bodies, which Dr. Carter says are of a pink colour in the fresh foot, were apparently mixed up with some crystaline material; but fatty matter so predominated, that it was almost impossible to free any section from it without resorting to boiling in ether and liquor potassæ. When boiling in the latter was resorted to, nearly all the fatty mass was held in solution, the residue being a very small quantity of connective or fibrous tissue. A greater portion of the bony mass also disappeared when treated in the same way. On the other hand, when the spores and mycelia of a fungus were subjected to a similar process, sufficient remained behind to enable any one to recognise the species, and without difficulty. The spores of fungi seemingly resist the action of boiling fluids, as they do prolonged and intense cold. We are therefore under no apprehension of losing all trace of them while subjecting animal matter to the crucial test of boiling in a destructive reagent. A prolonged microscopical examination yielded only negative results with regard to fungi. The cells and fibres which Dr. Carter says "are imbedded in black masses of matter" could nowhere be found; neither could any of "the fishroe-like substance made up of defaced fungous structure" be seen.

The papillæ were hypertrophied and mostly structureless; nothing like fibrous tissue or a capillary loop could be made out, even in sections from the sole of the foot. The epithelial and other layers were so blended, that not a perfectly-formed nucleated cell could be obtained. The pigment, generally so abundant in the skin of the black race of human beings, was nearly all removed. Portions of the sub-filamentous material occasionally presented an appearance somewhat resembling ciliated epithelium. These were readily broken down, and floated about in a mass of granular particles,

without nuclei, and only slightly fibrillated. Fat corpuscles abounded, either free or massed in cells, in some of which were seen groups of smaller corpuscles, giving a false appearance of nucleated cells. The subcutaneous infiltration of oily particles, and the disintegration of the various tissues, gave to all the specimens placed under the microscope a confused resemblance; and although some few bodies of a "spindle shape" were seen, it is impossible to conceive that they were either "ciliated epithelium," "degenerate fungi," or the altered forms of "a true oïdium," the material contents of the branching tubular canals of which have become altered through some kind of natural quiescence or encystment." If such encystment had taken place in this instance, it had become a complete disguise of all known fungoid characteristics; and under such a disguise it was not at all surprising that the late Professor Quekett should fail to come to any "definite opinion of its character."

In a more recent specimen sent to this country, I found decided evidences of algoid filaments. In this foot the sinuses were of a considerable size, and, when examined from within outwards, present a somewhat funnel-shaped appearance, but rather leading *from* than *into* the bones of the foot. The destruction of the small bones of the foot was curiously complete—the compact tissue being wholly removed, leaving behind only the open spongy portion, in the interior of which large and small nodulated masses of black matter, which, when fractured, looked like crystalline masses of stearine, mixed with the colouring matter of the blood. Sections of these bodies presented no evidence whatever of fungoid growth; and, although in a few other specimens in a semi-fluid condition flocculent filaments were found, I may fairly say that the small quantity of algoid matter mixed in any specimen examined was sadly out of proportion to the rest of the disorganised matter. Oily

particles, blended with fibrous and connective tissues, and often crystaline bodies in indescribable confusion, were the rule; while in a few instances semi-transparent yellowish scales of a more definite character were occasionally seen, blended with the fatty and granular particles. A portion of the black mass taken from the interior of a bone proved to be an exceedingly intractable substance. I submitted it first to the action of boiling alcohol and ether, neither of which reagents affected in any way the colouring matter or crystaline substance. Benzole, hydrochloric acid, and liquor potassæ were tried in succession, with a negative result. Boiling in sulphuric acid converted a small nodule into a bituminous liquid; but on the addition of water it was immediately precipitated in the form of scales. Hot nitric acid completely dissolved a mass with effervescence, giving off at the same time fumes of nitrous oxide, leaving only a perfectly clear yellowish solution behind. Fragments placed in a platinum spoon, and brought to a blow-pipe heat by a Bunsen burner, burned with a bright flame, and whilst so burning gave off a peculiarly pungent odour, leaving behind an exceedingly minute portion of whitish ash.

The attempted destruction of fungoid matter by the same reagents is not nearly so complete; and not until after long boiling in nitric acid is all trace of spores and mycelia lost. An excellent chemist and microscopist, at my request, submitted a portion of the mass to a chemical analysis, and found it to consist of fatty matter, phosphates of iron and lime, a little carbonate of lime, and a small quantity of an organic substance—albumen —not a particle of a fungus.* In one or two specimens

* The chemical composition of these masses resembles very closely the white stony concretions submitted to Gmelin, in 1821, by Tiedemann, who discovered them in the muscles of a man who died from the com-

I noticed the spores of a puccinia—"a vegetable parasite"—as well as minute fragments of vegetable tissue —cellulose—which probably might have been accidentally introduced.

The Rev. Mr. Berkeley believes "there is not the slightest ground for supposing that the disease depends on inoculation with the spores of the true parasitic fungi belonging to the rusts and mildews;" * and certainly a rather unusual view of the way in which the fungus spores enter through the sinuses is taken; for in this special specimen of diseased foot they presented the appearance of having been bored out by an animal rather than a vegetable parasite. But, admitting the sinuses to be either small or large, do they not in every case indicate a pre-existing state of disease, and of a very grave character? Another point of scarcely less moment is the less frequent variety of diseased foot—that is, the foot in which "degenerate fungi with numerous rounded bodies" are the chief elements of destruction—an earlier or more advanced stage of the disease than that in which fishroe-like bodies are found? Since in the first the fungi must have passed into a degenerate state, it certainly should be a more advanced stage—that is, so far as ordinary appearances and facts assist us in arriving at an opinion. The destruction of the various tissues in

bined effects of brandy, dropsy, and gout. Gmelin found them to consist of 73 parts of phosphate of lime, with a trace of iron, 7 parts of carbonate of lime, and 20 parts of animal matter similar to albumen or fibrine. Tiedemann believed them to have resulted from the violent attacks of gout; but this guess proved to be only a step in a later discovery made by Hilton and Owen—that these "concretions" were a species of hydatid—and which the latter observer, in 1828, proved to be the cysts of the dreaded trichina spiralis, and that the supposed concretions were due to the calcification of the cysts after the death of the spiralis worm.

* Rev. S. M. Berkeley "On the Fungus-foot of India." *Intellectual Observer*, vol. ii, page 248. 1863.

the first specimen of foot is certainly not greater than in those in which the mycelia of a fungus have been found.

The eminent mycologist, Mr. Berkeley, accepts the hypothesis of the fungus-foot disease, describes the fungus as a new species, and assigns to it a new name; and although "the fungus resembles closely the genus mucor," he nevertheless prefers to place it with chionyphe, a species "only found under snow," and concludes that "it is highly probable that many of our common moulds commence with a similar condition. The first indication of a change in tainted meat is seen to commence with little gelatinous spots of vegetation of various colours, the early stage of some curious species of aspergillus or penicillium." Hospital gangrene may, he thinks, also depend upon a similar cause. I think evidence is wanting in support of such a "probability," which is really no nearer the truth than the many guesses that have been made at a germ theory of disease.

To establish the fungoid origin of the diseased foot, it is absolutely necessary to show that the spores of a vegetable fungus can penetrate the healthy structures of an animal body during life; there germinate and destroy, one after the other, the fibrous, cartilaginous, and bone tissues, and ultimately kill the patient. The character of the tissues with which we have to deal seem to make this impossible; and the writer referred to has misgivings on the point, for he says:—"The little granular bodies are so closely involved in stearine, that their germination is scarcely probable." The general symptoms are, in my opinion, inconclusive and unpronounced in favour of fungus. "The foot swells up, is of a dark colour, numerous sinuses appear, with pink stains or streaks, which penetrate the subjacent tissues, and end in spherical groups of bright orange-coloured particles. The sinuses are more or less lengthy and tortuous, and will not usually yield to pressure of the probe," &c.

Nevertheless, it is expected that the soft yielding spores of a fungus will find their way through these tortuous sinuses, passing along in an opposite direction to a strong outward flow of sanious discharge, the usual accompaniment of such a condition of disease. It is not believed that the sporules, although minute enough, could enter through the circulation—a more generally stated opinion, and an equally probable mode of conveying the contagion to the internal parts of the body. The endemic character of the disease would be more easily accounted for in this hypothesis, as it occurs often in districts where the growing crops of rice are at times devastated by "smut," once thought to be the cause of cholera. But it could not be believed to enter through the blood, because in such a case it would be impossible to understand why the spores of a fungus should select a hand or a foot, and find in either a more congenial soil than in any other part of the human frame; or why one foot should be destroyed and the other escape; why the poison should stop at the part where the bones of the leg join the foot, and so forth.

The incubation of the disease demands a passing notice, as, according to Dr. Carter, it more frequently affects the agricultural classes, men in the vigour of life, and is not associated with constitutional causes, is not known to be transmitted—*ergo*, since agricultural labourers go about barefooted, and seldom wash their feet thoroughly, it is thought that the spores of a fungus will penetrate the very hard skin, and produce "worse ravages than the dreaded guinea-worm." Although I can easily understand how the guinea-worm makes its way through the skin of a native, particularly when softened by standing in water, I cannot see how the spores of a fungus should be capable of exerting the same force as an animal parasite provided with a mouth and jaws, and a pre-ordained desire to provide itself with a lodging

in the leg or foot of the first animal that crosses its path. It must be conceded, also, if the disease originates in a fungoid growth, there should be no instance of a foot that does not bear some evidence of the characteristic poison. Such a specimen as I have described, without a particle of fungus, places the hypothesis of a fungoid disease in a serious dilemma. My objection is in nowise met by saying that this form of diseased foot is exceptional; for, curiously enough, two out of three specimens I have examined present no positive evidence of fungus in any portion of the diseased mass, and the appearances observed scarcely come under the designation of flocculent filaments.

I will briefly describe the last specimen of fungus-foot disease sent to me by Dr. Blanc, of H.M. Indian Army, surgeon in charge of the Rajkote Hospital. The disease was found to be confined to the sole of the foot; it occurred in an unusually young person, a native, of 18 years of age, who had previously enjoyed good health; in whom, soon after coming into hospital, mycetoma was diagnosed by Dr. Blanc, who, on submitting a very small piece, which came away in a poultice, to microscopical examination, observed well-defined filaments of a fungus. The affected part of the sole of the foot was immediately excised, the wound rapidly healed, and in a short time after the patient was able to leave the hospital.

The specimen, preserved in strong spirits of wine, presented a hardened, shrunken appearance when it came into my possession. A small cut had already been made across the most prominent discoloured centre of the mass. This opening I enlarged for the purpose of removing small portions for microscopical examination; and finding nothing but quantities of fat-corpuscles and connective tissue, I dissected away a good deal of the surrounding structures, and came down upon two or three blackish-looking minute spots. With a low power,

an inch and a half, and condensed light, I made out a group of globular bodies, exactly like balls of soot, or one of the *Smuts* of the Ustilaginous species. On removing some of these small concretions, which proved to be too intractable for further microscopical examination, I placed them in a test-tube, covered them with liquor potassæ, and subjected them for a few minutes to a boiling heat. A small amount only of the colouring matter was dissolved out; but soon fragments were, however, soft enough to break up on a glass slide. A drop of glycerine solution was then added, and a thin glass cover placed over all. With a power of 350 diameters, I first observed numerous detached fragments of an orange-coloured resinous substance, a number of fat-globules and discoid bodies, with granular matter. On carefully focussing and illuminating the specimen by direct light, articulated filaments were seen imbedded, and slightly projecting beyond the edge of the coloured mass. When more magnified these were converted into free loops, not unlike papillæ. The fungus threads were for the most part exceedingly minute; there was a compressed or fossilized appearance about them, if I may so express it.

On increasing the magnifying power to 650 diameters, these threads were resolved into long, jointed, dissepimented cells; some branching out and attaining to a considerable length, while others terminated in an enlarged ovoid head, probably a spore receptacle, containing one or more spores. In others, again, a minute oil-globule apparently occupied the centre; but it is not easy to determine this point, from the large quantity of colouring matter present. A peculiar budding out was noticed in some of the globose cells, and a few bodies separated away from the coloured mass were of a paler colour, and partaking of an amœboid form. These latter somewhat reminded me of Haeckel's Leptocytode, from the cytode

of which this histologist says: "a homogenous membrane is differentiated from the granular contents; prolongations are thrust out, and ultimately become a free-moving body, a Protamœba primativa." The walls of the filaments appear in some instances thick, while those which were separated from the homogeneous matter were exceedingly thin and transparent. Notwithstanding the boiling in liquor potassæ, large quantities of fat-granules continued to float about, and the carbonaceous colouring matter was not nearly removed. The growth in some particulars, save that of colour, appears to partake more of the nature of a confervoid plant in its simple articulated threads and cell multiplication, than of a "truffle-like fungus." But as "one swallow does not make a summer," neither does one examination enable one to write or speak with much authority on fungi. I should prefer, in all examinations of the lower forms of life, to see a hundred examples of the same organisms present before asserting anything decidedly about them. I must again repeat that, so far as I am able to draw a conclusion from the specimens of the fungus-foot I have examined, and, considering the relatively small proportion the fungoid filaments bear to the diseased mass, the fungus must only be regarded as a secondary product; one which may aggravate disease, but can hardly originate it.

In the case just described, the spores of a fungus may have been forced into the sole of the foot when the young man struck it against the sharp stone, as already stated, and cut it. The cut healed up, although in about six months it became very painful, and an abscess subsequently formed. Poultices were applied, in one of which a small blackish body was noticed; and this, upon microscopical examination, proved to be fungus. It is, therefore, probable that spores or the filaments of a Leptotrix, parasitic smut, found its way into the wound at the moment the first accident occurred.

After a careful examination of all the facts, I am bound to consider that the foot disease of India appears to commence in an error of nutrition; phlegmonous inflammation and diffuse suppuration follow, and spread from one tissue to another. Specific blood-poisoning, hypertrophy, and increased cell-development, soon pass into complete disintegration of tissue, vessels, nerves, &c. The process of retrogression, at first slow, proceeds to rapid destruction, and soon the albuminoid, oleaginous, and crystaline constituents are blended in an incongruous mass. The fatty matters assume, in connection with the flattened connective-tissue cells, an angular, a spindle, or even a mulberry shape. It is obvious that the colouring matter of the nodulated masses must be derived from the iron of the blood; and sanious fluid, with fat, stearine, and phosphatic matters, blend into the carbonaceous masses—"fishroe-like bodies"—which are seen to fill the cavities of the bones. The slow disintegration of the various structures in the Madura foot-disease is no doubt greatly exaggerated by the ordinary effects of a tropical climate, often an important factor in disease, and one well exemplified in those remarkable forms, elephantiasis and leprosy, both of which seem to originate in an error of nutrition, brought about by arrest or destruction of the nerve fibre, and ending in a complete metamorphosis of all the structures.

To summarize the conclusions to which I have been led, from the various observations, examinations, and experiments, it appears almost beyond a doubt that there exists but one essential organism, a fungus whose spores find a soil common alike to the surface and the more secluded parts of the human or animal body; that variations in skin diseases, associated with a parasitic growth, are due to differences in the constitution of the person affected; to the moisture, exudation, soil, and temperature under which the development of the fungus

takes place. Consequently it is neither correct nor desirable to separate and classify them as "*parasitic diseases of the skin.*" That parasitic growths vary but little in any case, and then only in degree, not in kind, some soils appearing to be better suited than others for their development, that furnished by the eruptive or secreting surface being in every way the most congenial; while diversity of form in all cases arises from growth taking place either upon a sickly plant, a saccharine solution, or an animal tissue. That fungi generally excite chemical decomposition in the soils on which they feed; and it is the exclusive province of a certain class, when spread on the surface of an albuminoid, saccharine or alcoholic, or slightly acid liquid, to develope and grow, and during growth to give rise to either the alcoholic, acetic, or putrefactive fermentation.*

A Fungoid or Organic Germ Theory of Cholera and other Diseases.

A fungoid theory of disease, of the zymotic, epidemic, and endemic forms especially, has been proposed, and

* "Numerous facts justify the belief that there exists but one essential fungus, whose sporules find a soil for development and growth upon the surface, or even within more secluded portions of the human body, and that varieties in the growth of the fungus are due to differences in the constitution of the individual, to the moisture, exudation, soil, or temperature under which the development of the fungus takes place. It excites a chemical decomposition in the pabulum on which it feeds, and the different stages in its growth give rise to alcoholic, acid, and putrefactive fermentation. Of the latter there is ample evidence in many of the parasitic skin diseases, and especially in favus, the odour of which closely resembles that of some methylamine compound. (Lowe.) Thus, their irritant action may very soon establish an eruption."—*Aitken's Science and Practice of Medicine*, vol. ii, p. 179. 2nd edition.

surrounded by endless speculations, some of which it is said explain satisfactorily the cause of these affections, their mode of incubation, and contagious nature. From the position occupied by the advocates of the theory, rather than any other cause, it has in a measure taken possession of the public mind; and while the profession may appear partially agreed as to there being a specific poison for some forms of disease, it is divided upon what may be described in two words as the "vital germ theory" and the "physical theory" of disease.

Those who hold fast to a fungoid or germ theory, believe that the poison takes the form of living vegetable organisms, which are rapidly developed, and capable of exciting, under special conditions, either fermentative or putrefactive changes in bodies; and without them there is no fermentation, no putrefaction; and that under certain circumstances these are poisons, and act as such, and are the exciting cause of zymotic diseases in the animal body. But, in defining the processes set up by these germs, and accounting for certain symptoms relating to these diseases, the theory fails to explain how a disease so readily communicable as scarlet-fever is more frequent before ten years of age, and why there is immunity from a recurrence of this fever, or small-pox; why selective in respect to season; why the majority of those affected recover—and for the most part recover as it were spontaneously; or why, when a person is infected, there should be recovery at all? A number of similar questions suggest themselves, and I have here presented only those that seem to me to remain unanswered by the advocates of a germ or fungoid theory of disease.

With regard to the "physical theory," the advocates of which believe that while the organic elements are poisonous and colloid in structure, that they are capable of being transmitted as solid matters in water or air, and at the same time are destructible. Their action on the

animal body is said to be purely physical, and the advocates of this theory wisely decline to offer any decided opinion upon the changes brought about, whether of a fermentative or putrefactive character.

I endeavoured at one time to trace the history of the fungoid or germ theory of cholera; and in a paper read before the Medical Society of London, March, 1870, and also in papers contributed to the *Medical Times and Gazette* of the same year, the results were duly chronicled.

Dr. Tytler, I believe, was the first to connect cholera with diseased food, during an epidemic visitation at Jessore, in 1817. He asserted that it was occasioned by the consumption of unsound rice. But when, in 1833, he exhibited his specimens to the Medical Society of London, they proved to be "ergoted rice." Now, although rice infected with ergot has been known to produce fearful results, the symptoms of poisoning differ widely from those of cholera. In 1861, a gentleman lost six horses in a very sudden and suspicious manner. His belief was that they had been poisoned, and a veterinary surgeon agreed in this; but, upon making a careful post-mortem, he could find no trace of poison. The food was then examined, and some oats attracted attention. My friend, Professor Tuson, sent a portion of his supply to me for examination. I noticed that the grains were matted together in lumps, by a sort of cobweb-like material. Upon breaking them up, a blackish-looking powder was deposited on the paper; placing some of this under the microscope, "bunt" and other spores were detected, and I was able to clear up the mystery, and confirm a suspicion that death was due to a cumulative poison swallowed in large doses in the food, which starved rather than nourished the animals. Numerous well-authenticated instances of a similar kind might be given; but this is unnecessary.

Dr. Wallace, of New York, in 1845, endeavoured to

connect epidemic disorders generally with fungi; and Dr. Cowdell, in 1848, published a work entitled "A Disquisition on Pestilential Cholera, being an attempt to explain its phenomena, nature, causes, prevention, and treatment, by reference to an extrinsic fungus origin." At p. 202, these remarks occur:—"The conclusion at which we have arrived as to the nature of the cause of pestilential cholera is, that it is a minute fungus, probably resembling the *Torula cerevisiæ*."

Dr. Mitchell, of Philadelphia, in 1848, in a work on the origin of malarious and epidemic fevers, writes:—"The cryptogamic theory will well explain the peculiar domestication of different diseases in different regions which have a similar climate—the plague of Egypt, the yellow fever of the Antilles, and the cholera of India. We have only to suppose, what is known to happen in other cases, that the fungi, on which cholera is assumed to depend, acquire at times, as do the germs of some contagious diseases, an unusual power of reproduction and diffusion, and a greater potency of expansion. Such germs may be carried by men, and goods, and ships; or be scattered by the winds, to regerminate wherever special conditions are found. Thus can we see why the poison prefers the route of streams, or infects the damp parts of cities; and why classes living in clean apartments, in dry districts, suffer so little."

In this author's writings we find a well-woven hypothesis of cholera, one which it appears to be hypercritical to attempt to demolish. It is first necessary to mention the supposed discoveries in the same direction of Drs. Swayne and Brittan, who published (*The Lancet*, October 6, 1849) an account of their examinations of cholera evacuations. After repeated microscopical investigations, these gentlemen convinced themselves that fungoid and other bodies found in the rice-water discharges of cholera patients were characteristic of the disease. What at

that time was considered more conclusive, Dr. Budd announced that he had succeeded in detecting the same bodies in the water of several districts where cholera prevailed. Here was a wonderful confirmation of the fungoid origin of cholera at last. It so happened, however, that some of the evacuations and specimens were sent to Mr. Busk for examination, and, at a meeting of the Microscopical Soc. Oct. 17, 1849, he demonstrated that the large bodies figured by Dr. Swayne were merely "a species of *Uredo*, a kind of smut frequently found on wheat," exactly like specimens noticed by this experienced microscopist in a loaf of brown bread purchased the same day at Greenwich. *Uredo* is not destroyed, as I have said, by boiling in caustic potash, and it readily passes, unaltered, through the intestinal canal. Other bodies, supposed to be peculiar to cholera evacuations, were, at the same time, seen to be starch granules and portions of the cellular structure of the inner coat of the bran of wheat.

Professor Hallier, a botanical teacher of Jena, on examining the contents of the bowels of patients attacked by cholera during two more recent visitations, believed that he had discovered the active agent or cause of the disease. He detected in the evacuations spores, or seeds, and filaments, or roots, of a fungus. Hallier, like his predecessors in these inquiries, attempted to cultivate these spores, and in due time produced, as he thought, another fungus belonging to the genus *Oïdium*. Continuing to pursue his investigations, he found he could produce from *Oïdium* another fungus, *Urocystis*, a vegetable parasite. The dark-coloured spores of *Urocystis* are very characteristic, and often infest the leaves of plants, but have never yet been suspected of having any connection with *Oïdium* or "mould;" nor can it be proved that this fungus attacks the grain of any food plant; the spores have never been detected on the leaves

of the rice plant. Unfortunately, then, for his theory, Hallier assumed too much; for the entire foundation of it was based on an assumption that moulds are related to *Ustilagines*, or "smuts and bunts;" for "moulds," he says, "are mere unripe fruits of *Ustilagines*." He believed that his so-called "micrococci" travelled with the rice plant from India, and entered the stomachs of persons, and destroyed the villi of the intestinal canal with amazing rapidity. Hallier has, however, after mature consideration, seen fit to change his ground a good deal, and now says that he is not convinced that any infectious disease can be caused by spores or fungi *per se*. He also considers that there are ripe and unripe forms of "moulds;" and, on occasions even when ripe spores are cultivated on a weak and poor soil, they do not produce "cholera contagium;" so that, although large quantities of spores may occasionally be swallowed, they may not be retained long enough in the intestinal canal to produce ripe micrococci, and they then pass through inocuously. He further describes micrococci to be particles of a plasmic mass without cell walls, requiring the highest powers of the microscope in skilled hands to detect them. A high temperature, he says, is necessary to maintain these micrococci in an active condition; and therefore only during warm weather, the summer of European latitudes, could it be expected the fungus would germinate and propagate as in India. Thus driven from his original proposition that cholera is due to the *Urocystis* form of fungus, he adopted another which deserves no more confidence at our hands. Indeed, it has been, and can be again, most conclusively shown that diseased rice takes no part whatever in the production of cholera. Rice is rarely eaten uncooked, either here or in India. It is always boiled, and well boiled, so that anything like vitality or germinating power is probably destroyed. But supposing that spores of any

kind were found adhering to rice grains, and taken into the stomach, would they remain there long enough to germinate? Certainly not. The spores of the edible mushroom require to be passed through the stomach of the horse; but, instead of germinating there, they only germinate in the excretions after exposure to a moist air; and it by no means follows, because the spores of the mushroom may be taken from the dung of the horse and made to vegetate, that a crop of mushrooms could be produced in the intestinal canal of the animal. The notion is preposterous.

We begin to find out that fungi are curious organisms. The spores of one species will not germinate until they have suffered the probation of the horse's stomach; another species requires to pass through a similar probationary stage in the stomach of another animal. If, however, it should be found that *Oïdium* germinates in the human stomach, and that the intestines are the natural habitat of the fungus, should we not expect to find spores in the excretions of those in health as well as in disease? At all events we ought to find Hallier's unripe forms of *Ustilagines* in health as well as disease.

Experiments such as those made by Hallier upon mice, feeding the animals with bibulous paper steeped in choleraic putrefying evacuations, cannot be accepted as at all conclusive. Dr. Thudichum, upon carefully repeating them (I quote Dr. Thudichum's experiments rather than my own), found that out of 51 mice 13 only became ill; 11 of these died, 2 recovered, and the remaining 38 were unaffected. The poison was active only between the fourth and tenth days, which is exactly the period when a chemical change is found to take place in the proportions of nitrogen and carbonic acid contained in it; and from this Dr. Thudichum argues that its power for evil depends on the evolution of hydrogen. If the poisoning were caused by fungi, all the animals

should have been infected, or, at all events, there should have been no immunity for any length of time during which choleraic matter was administered. The conclusion arrived at by Dr. Thudichum is, that the decomposition which takes place is such as might have been expected from the putrefaction or decomposition of albuminous matter by chemical processes, and not by any fungoid fermentation as the action is going on in parts of the body into which fungi have never been alleged by the advocates of the fungoid theory to penetrate. An examination also of the cholera excreta by the spectroscope negatively confirms this view. It shows that a somewhat complicated alteration of the chemical condition of the blood takes place during the rapid progress of cholera disease.

I must not omit to notice the more recent researches on this important question made by Drs. Lewis and Cunningham at the instigation of the Indian Government. Particular attention appears to have been directed by these gentlemen to the changes produced in the blood of cholera patients, as well as "experiments on the introduction of organic fluids into the system." The microscopical characters of the blood were observed by means of Stricker's warm stage. "A small drop of blood having been received on the centre of a carefully cleaned covering-glass, the latter was pressed down on the wax cell and hermetically sealed. The cell was deep enough to prevent the blood from coming into contact with the slide, and therefore allowed its free exposure to the included air." In this state, large numbers of specimens were retained for examination without any danger of the admission of extraneous elements, and a series of remarkable changes in specimens of cholera-blood were noted. For instance:—the number of white corpuscles at first visible was small; but with the widening of the ring of serum a series of phenomena gradually occurred,

beginning at the close of one hour after the blood had been drawn. These changes are thus described. "Normal-sized white corpuscles began to migrate into the fluid; but in addition to these, and in far greater numbers and activity, were much larger and more delicate bioplastic bodies; cells they were not, for they had not at this time the faintest differentiation of wall, contents, or nucleus. They were simply masses of fluid bioplasm—bioplasm so fluid and diluted as in many instances to be almost, if not entirely, indistinguishable by refraction from the surrounding medium. Gradually the consistence of these large bioplastic masses appears to increase, and they, as it were, grow into sight. Their movements are extremely constant and free—no mere alterations of form, but free progression, along with such movements. The alterations in form vary extremely, sometimes consisting of the emission of rounded and lobulated protrusions, and at others of the running out of elongated slender extensions and threads." Similar bodies may at the same time be seen in the serous spaces of the clot. After a time they begin to divide, and give rise to a second generation of bioplasts, smaller, though scarcely less active. But at the close of twenty-four hours from the commencement of the examination, only a few remain freely mobile; the majority have considerably increased in size, whilst they have also become denser in substance and more full of granules. At this stage they are more or less spherical, and are not at all unlike pus-corpuscles. During all this time, moreover, the serum remains clear and free from all traces of bacteria. The specimen may remain in this condition, comparatively unaltered, for weeks, though the bioplasts in the majority of cases pass on to further changes.

Other important facts have been made known by these investigations bearing upon the "germ theory" in its application to cholera. In the specimens of blood

submitted to immediate investigation, not the faintest trace of bacteria was detected in any instance, although they were carefully searched for under high magnifying powers; and, as a rule, such organisms were singularly absent from the specimens submitted to continued observation. The authors say, "One of the most important points determined by these observations is the fact that the blood in cholera is, as an almost invariable rule, free from bacteria, either actual or potential. This is the case as well, shortly after death as during life, and holds in regard to every stage of the disease. In one or two cases a slight development of distinct bacteria has occurred during the course of observations; but this is no more than may occur in the most healthy specimens of blood (owing most likely to accidental contamination); and the idea that bacteria are normally present in the blood in cholera may be finally dismissed." With regard to the presence of fungus-germs as a characteristic of the disease, "There is absolutely nothing in favour of any such view; there is absolutely no evidence of the existence of fungoid elements in the blood whilst in the body, and only very rare and clearly accidental development of such bodies after its removal from it."

There seems good reason for believing that the statements which have been made concerning the existence of organisms in the blood of cholera-patients, and of persons suffering from other acute specific diseases, have been based upon more or less obvious errors. In the first place, mere molecular *débris* have doubtless often been cited as the so-called "micrococci" of Hallier; whilst, on the other hand, cultivation-experiments with the view of developing actual or "potential" germs are liable to be vitiated by numerous sources of fallacy, and have given rise to many other erroneous statements.*

* *British Medical Journal*, Feb. 22, 1873.

Dust and Disease.

With regard to the sensational cloud of "dust and disease" which an eminent Physicist raised, and thought proved a connection between the minutely divided particles of matters diffused through the atmosphere, and the production of disease. This is a question of some importance; and before I proceed to discuss it, let me clear the ground of anything having the semblance of an ambiguous meaning, such as is likely to occur by blending together the terms "organic germs" and "organic particles." I am ready to admit that dirt is always floating about in the air of towns in pretty considerable quantities; but I am not prepared to look upon this as "organised matter;" neither can I admit that the two terms are either synonymous or convertible; for although there are many particles floating about in the atmosphere, it has not been proved that "organic germs" (that is, seeds of living organisms, because that is what we understand by this term) at all times and seasons enter largely into the composition of the air we breathe.

This question has been ably investigated by Dr. Angus Smith, who was long engaged in determining the relative condition of organic and other matters in the air of towns, and its probable effect upon the health of the inhabitants. This chemist and physicist found that the chief cause of the insalubrity of the air of towns consists, not in "organic germs," but in the emanations from human beings too closely packed together, and the noxious gases generated by coal thrown off by manufactories and the large numbers of dwelling houses. These tend to saturate the air with matters of the most injurious kinds —as sulphuretted hydrogen, sulphuric and hydrochloric acids, ammonia, chlorides, and albuminoid matters— that are far more injurious to health and life than "organic germs." Dr. A. Smith is bound, therefore, to withhold his assent to anything like an "organic germ"

theory, because he believes it has not been shown by its advocates to have any relation whatever to disease, and is likely to divert attention from causes far more important. Professor Wanklyn also proved by his ammonia process that the total quantity of organic nitrogenous matter passing out of the lungs and held in solution in the form of watery vapour during the space of twenty-four hours in health amounts to about three grains. In disease it increases, and even in health the quantity of free ammonia varies considerably. Dr. Ransome likewise ascertained that a larger quantity of organic matter is thrown off in Bright's, and some other diseases; while in catarrhs, measles, dipththeria, &c. a great deficiency is noticed. This fact scarcely chimes in with the "organic germ" theorists, who assert that large quantities of albuminoid matter, vibrios, &c. are found in the air-passages in catarrhs and other diseases.

With regard to the filtration of air through cotton wool, this does no more than arrest the moisture thrown off by the lungs saturated with ammonia and other salts. It is now several years since Professor Tomlinson, of King's College, showed how impossible it is to keep any vessel chemically clean, or even decently free from the dust floating about in a closed-up room. He found that corking up bottles did not prevent the entrance of particles of matter; and, after many trials to exclude the dirty atmosphere, he tried cotton wool, and found, by placing a pledget of this material quite loosely in the necks of bottles or glass tubes, they remained perfectly clean for many days. This chemist, by employing flasks or bottles thus prepared, was also enabled to delay the crystallisation of saturated solutions of salts to an almost indefinite period. He excluded in this way all particles of inorganic matter which at once form a nucleus of crystallisation; but such particles of matter are easily detected, and are certainly not to be confounded with "organic germs." The members of the medical profes-

sion have not lagged behind in a matter of this kind; but, on the contrary, have taken the initiative in the use of cotton wool inhalers for those engaged in deleterious manufactures, and in places where a large amount of organic or mineral matters are given off. Dr. Angus Smith in his report upon the air of mines, 1854, particularly dwells upon the danger to the health of the miner produced by taking into the lungs through the open mouth a large quantity of coal-dust and mineral matters. "If," he observes, "as you approach the entrance of a pit, a gleam of sunlight happen to play across it, you will at once perceive an immense quantity of solid matters issuing forth in an endless stream. The impure air of the mine is loaded with these solid particles, which, when caught and submitted to microscopic examination, are found to consist of coal, crystaline bodies, &c.; and if issuing from iron mines, there are, in addition to those named, fine metallic atoms, products from gunpowder explosions, arsenic in small quantities, and the sulphides of various metals. With a given quantity of inspired air, the miner takes into his lungs from sixty to eighty grains of such impurities each day; so that it will be readily understood that such dust and dirt must in a very short time exert a very injurious effect upon the lungs and other organs of the body." To prevent the entrance of such matters into the mouth and lungs, Dr. Smith proposed the use of a simple respirator, made of a layer of cotton wool, placed between wire gauze, which could be made for a few pence. But, after all, these noxious matters bear no proportion to the ordinary condition of the atmosphere. If a larger proportion were mixed, the respiratory tract is well taken care of, being freely supplied with cilia, ciliated epithelium, which remain in action, sleeping or waking; by their agency a sort of churning process is carried on, amply sufficient not only to arrest the further progress of any foreign body, but probably to kill "organic

germs," and effectually prevent their germination in the internal organs; and when particles enter in large quantities, additional means are provided for their expulsion by the acts of coughing and sneezing. Much of the foreign matter inhaled collects in the throat, is entangled in the mucous secretion, and expelled by expectoration.

Those who know little of the microscope and the perfection to which the modern instrument has attained, believe that the germs spoken of in his cloud of dust cannot be seen by its aid, nor appreciated in any way, except by watching their play across the path of a ray of solar or electric light. This is not the fact; they can be easily taken on glass slides in suspected places, and in a very short time. If I take an ordinary slip of glass, and smear it over with glycerine, and expose it for a moderate space of time either in my room or in the open air, I find, when examined under the microscope, a quantity of small particles deposited thereon, such as articles employed and in domestic use at the moment of exposure would throw off, chiefly consisting of mineral and vegetable substances—as fragments of coal, granite, brought in on the dress or shoes from the street, vegetable hairs, cotton, as well as wool fibres detached from the clothing; these are often mixed with a few starch granules from the bread, and occasionally a few spores of fungi. In the house, the latter form but an inappreciable proportion, while in the open air we often take a good deal; and during the warm damp weather peculiar to some periods of the year, a larger quantity of fungus spores and particles of vegetable hairs will be deposited on the slides. By employing a more scientific method, as by the use of an aspirator, which draws in a larger quantity of air in a given time, Pasteur and others collected the same kind of substances. If I put a small quantity of distilled water into the bottle before the air is drawn through by the aspirator, I also find, in the course of a

few days, some of the lower forms of animal life developed in the fluid. This experiment, it is thought, seems to prove the spontaneous generation theory, heterogenesis, of animal life.

The microscope has clearly demonstrated the nature of these various substances floating in the air; and it is more than probable that a few escape detection, either from their extreme minuteness or transparency; but those who have investigated the subject will agree with me that it by no means follows that the air is filled with organic particles, or contains more than a very small proportion of "organic germs." Dr. Angus Smith determined the relative proportion of organic matter in pure air to be 1 grain in 200,000 cubic inches, while the most impure air of towns contains often as much as 1 grain in 8,000 or 10,000 cubic inches of air. But every step in such an inquiry is surrounded by incomprehensible difficulties. We can no more understand these floating germs than we can how the perfume of a flower is diffused through the air, or how a grain of musk should give off its peculiar odour for the space of twenty years, and not become perceptibly diminished in bulk. We are equally unable to explain why, out of twenty persons breathing a loathsome air, one will breathe in a fatal dose, and nineteen escape the malarious poison. I must confess I do not believe that if the twenty were breathing through cotton wool filters the relative condition of health and disease would in any way be altered. Aristotle found no difficulty in believing, and in inducing others to believe with him, that worms and insects were generated by dead bodies; and it was only towards the end of the seventeenth century Redi succeeded in demolishing this theory, and proving that worms and insects which appear in decaying bodies are produced from the ova deposited there by the mature parent. It was, however, thought to be altogether preposterous to suppose that putrefaction could produce an insect (neither could it), and this

explanation was at the time utterly rejected as fallacious. Driven from the insect world where such an hypothesis could have no chance of success, the disciples of Aristotle sought refuge in the world of fungoid life, or "organic germs." But here we arrive at an immense gulf, which requires to be bridged over before we arrive at the portal of truth. I have no doubt that the hypothesis of the production of disease by "organic germs" first obtained credence simply because we know of something analogous occurring in the flight of insect life, and the propagation of swarms which inflict blight on vegetable life. To associate such a phenomenon with the occurrence of disease in animal bodies is most unreasonable and unsatisfactory. From an "organic germ" to a "specific germ" theory seems to be a natural transition; and certainly the most plausible affiliation of a disease with the "specific germ" theory is cholera; but even here it is seen that opinions are more and more divided.

I must say, if we assign a specific germ theory to cholera, we have to deal with a migrating malaria, a wandering cause of disease not confined to hospital, house, or district, capable of being diffused through the atmosphere and conveyed along vast tracts, affecting different places with a varying intensity which no known conditions of atmosphere will explain, but nevertheless possessing the power of reproducing itself, so as to spread the disorder by fresh creations of the original conditions which produce it. Microscopical and chemical examinations of the atmosphere of the wards of the hospitals in which large numbers of cholera patients have been treated, afford no reliable solution of the question. Mr. Rainey and Dr. Thomson, in 1855, made every attempt to isolate the supposed "cholera contagium" in the wards of St. Thomas's during the epidemic visitation of that period, but without success. They only discovered particles of vegetable hairs, coal dust, epidermic scales, starch, with occasionally a few spores

of fungi; but the results obtained were thought to be unsatisfactory; nor did there appear any grounds for a belief that these organic germs had anything to do directly or indirectly with the prevalence of the disease. The remarkable coincidence of the spores of "rusts" and other fungi, noticed by many during the first outbreak of rinderpest, led some to suppose that this disease was due to the spores of fungi; but this opinion was soon exploded.

Admitting fungi cause cholera, will it explain the suddenness of the attack? It is out of character to suppose that a few fungi, more or less, will kill suddenly, or in the course of six or eight hours. If the specific germs lie dormant, and are capable of assuming other forms, then why are they not found in this state prior to the attack, or during a condition of health? Hitherto all the bodies found during life have been satisfactorily traced to food, or are the natural products of the mucous membrane. What then, may I ask, has positively been made out with regard to the fungoid bodies or organic germs in the production of disease? The most carefully conducted examinations have as yet produced only negative results. That most common form of disease in which fungoid bodies are found—Leptothrix—is known to arise from a neglected condition of the mouth and teeth, and is readily cured by a proper use of the tooth-brush.

Aphthæ, thrush, a disease of infancy, is said to be caused by a fungus. It occasionally affects grown people, is chiefly confined to the mouth, and consists of small irregular whitish-looking patches, which are scattered over the surface of the mucous membrane. The aphthous patches look at first like particles of curd; these fall off and leave behind them a reddish, raw-looking surface. Successive crops of aphthæ reform, and, with the addition of fungoid spores and filaments, often prove troublesome and dangerous to the little patient.

The disease occurs at an early period of life, is seldom seen after teething is completed, and the child is able to partake of other food than milk; it is therefore believed to be produced by the unhealthy condition of this fluid; or, if the child is brought up by hand, to an improper diet of some sort. In all cases, acidity of the stomach is present; and this points to the necessity for attention to diet in attempting a cure of the disorder. When thrush occurs in the adult, it denotes a considerable amount of debility, and requires the aid of tonics, bark and ammonia, with wine and a nourishing diet, to sustain the strength and restore the health.

Aphthæ are formed on surfaces that are provided with a continuous epidermis, and especially indicate a low condition of the system; at such a time the fungus, which is the oïdium albicans, finds a suitable soil to feed upon, and soon becomes a destructive agent demanding attention.

All disease is simply a disturbance of the constructive and assimilative processes whereby the normal integrity of the animal body is maintained. The cause of jungle-malaria, and fen-ague, may be traced to accumulated and decaying organic matter. By breathing for a given time an atmosphere loaded with sewer and other gases, typhoid fever is produced; other fevers can be traced to similar causes. Indeed, many diseases classed among zymotic can be accounted for without assuming the existence of germs or spores. The blood in all cases is primarily affected, and when a disintegrating action is set up in any part of the animal economy, its tendency is downward; the effect that follows varies only with the histological anatomy of the part. The action is a nearly uniform process of irritation, inflammation, and disintegration, tending towards death.

I do not therefore deny the probable influence exercised by minute organic particles mixing in the air we

breathe, in the *summum malum* of human ills; but what I contend for is, that as yet it has not been demonstrated that such bodies hold any precise relation to any special form of disease. It has, indeed, been repeatedly shown, since Boehm's experiments in 1838, that fungoid bodies are a constant accompaniment of other debris; and these are found soon after death in abundance throughout the whole extent of the intestinal tract—so soon that they actually appear to have grown, or commenced their growth before death. So much remains to be done in this difficult inquiry, and so many doubtful points require clearing up before it can be truly said cholera or any other form of disease has its origin in a fungoid growth, that, if we are not more cautious, we shall find the cholera contagium what Boeck has aptly described it to be—"the infusorial chaos of the intestines."

If any one is determined to furnish a formula for cholera, he may take "bad air, bad water, sewer emanations, floating stinks, germs if you please, bad ventilation," with perhaps a dozen or two more evils, which are all more or less concerned in originating the disease. But, after all, the prime occasion for its development is a mass of human beings aggregated together, either in towns, in barracks, or the country, into a sufficiently limited area of mud, gravel, granite, large and imposing structures, crowded courts, alleys, cellars in St. Giles's, or attics in Glasgow; and the necessary conditions for cholera as well as other zymotic diseases are provided. A vitiated state of atmosphere breathed and re-breathed until it becomes lung-tainted and poisonous, to which is added bad water, bad food, bad lodging, or some chronic disease assisting to lower the vital functions, and our choleraic catalogue is exhausted.

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